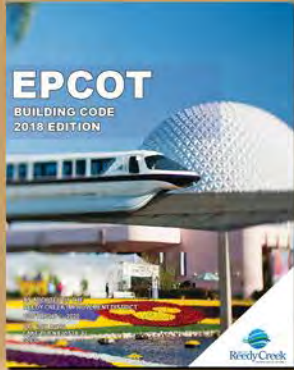


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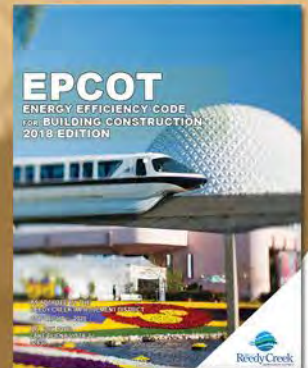
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FOREWORD

The purpose of the *EPCOT Accessibility Code for Building Construction*® is to serve as a comprehensive regulatory document to guide decisions aimed at protecting the public's life, health, safety and welfare in the built environment. This protection is provided through the adoption and enforcement, by state and local governments, of the performance-based provisions contained herein.

The use of performance-based requirements encourages the use of innovative building designs, materials and construction systems, while at the same time recognizing the merits of the more traditional materials and systems. This concept promotes maximum flexibility in building design and construction, as well as assuring a high degree of life safety.

The *EPCOT Accessibility Code for Building Construction* incorporates, by reference, nationally recognized consensus standards for use in judging the performance of materials and systems. This provides for the equal treatment of both innovative and traditional materials and systems, provides for the efficient introduction of new materials into the construction process and assures a high level of consumer protection.

The *EPCOT Accessibility Code for Building Construction* has been adopted pursuant to Section 553.503, *Florida Statutes* and based on the 2010 *ADA Standards for Accessible Design*.

PREFACE

Introduction

Internationally, Code Officials recognize the need for a modern, up-to-date accessibility code addressing the design and installation of systems through requirements emphasizing performance. The *EPCOT Accessibility Code for Building Construction* is designed to meet these needs through model code regulations that safeguard the public's health and safety in all communities, large and small.

This comprehensive accessibility code establishes minimum regulations for systems using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new system designs.

Marginal Markings

Solid vertical lines in the margins within the body of this Code indicate a change from the requirements of the 2015 edition, except where a change was minor. Deletion indicators (➡) are provided in the margin where an entire section, paragraph, exception or table has been deleted if the deletion resulted in a change of requirements.

General Notes

Background shaded text indicates advisory notes as well as changes to the 2010 *ADA Accessibility Guidelines* (ADAAG) and requirements based on Florida law.

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CHAPTER 1

APPLICATION AND ADMINISTRATION

SECTION 101 PURPOSE

101.1 General. This Code contains scoping and technical requirements for accessibility to sites, facilities, buildings, and elements by individuals with disabilities. The requirements are to be applied during the design, construction, additions to, and alteration of sites, facilities, buildings, and elements.

Advisory 101.1 General. In addition to the 2004 ADAAG requirements, covered entities must comply with the regulations issued by the Department of Justice and the Department of Transportation under the Americans with Disabilities Act.

The Department of Justice regulations 28 CFR, Part 35 and 28 CFR, Part 36, the Department of Transportation 49 CFR, Part 37 and the requirements of Florida law Part II, Chapter 553, F.S. have been incorporated in this Code.

101.1.1 This Code shall take effect March 15, 2012. After July 1, 2011 and prior to March 15, 2012 this Code may be used to comply with Chapter 2011-222, Section 29, Laws of Florida.

101.1.2 All new or altered public buildings and facilities, private buildings and facilities, places of public accommodation, and commercial facilities subject to this Code shall comply with this Code.

101.1.3 This Code establishes standards for accessibility to places of public accommodation and commercial facilities by individuals with disabilities. This Code shall also apply: to state and local government facilities pursuant to Section 553.503, F.S.; to private clubs pursuant to Section 553.505, F.S.; and to residential buildings pursuant to Section 553.504(2), F.S., and the *ADA Standards for Accessible Design*. It is to be applied during the design construction and alteration of such buildings and facilities as required by this Code.

101.1.4 This Code is not intended to expand or diminish the defenses available to a place of public accommodation or a commercial facility under the Americans with Disabilities Act and the *ADA Standards for Accessible Design*, including, but not limited to, the readily achievable standard and the standards applicable to alterations to places of public accommodation and commercial facilities.

101.2 Effect on removal of barriers in existing facilities. Removal of architectural barriers, pursuant to 28 CFR, Section 36.304, from buildings, structures or facilities shall comply with this Code's requirements for alterations unless compliance would render the removal not readily achievable. In no instance shall the removal of an architectural barrier create a significant risk to the health or safety of an individual with a disability or others.

This Code applies to alterations to existing facilities that are subject to the barrier removal requirement under Title III of the ADA to the extent required by regulations issued by the Department of Justice incorporated in Subsection 202.6.1 and to alterations undertaken by Title II entities to provide program access.

This document does not address existing facilities unless altered at the discretion of a covered entity. The Department of Justice has authority over existing facilities that are subject to the requirement for removal of barriers under Title III of the ADA. Any determination that this document applies to existing facilities subject to the barrier removal requirement is solely within the discretion of the Department of Justice and is effective only to the extent required by regulations issued by the Department of Justice.

SECTION 102 DIMENSIONS FOR ADULTS AND CHILDREN

102.1 Dimensions for adults and children. The technical requirements are based on adult dimensions and anthropometrics. In addition, this Code includes technical requirements based on children's dimensions and anthropometrics for drinking fountains, water closets, toilet compartments, lavatories and sinks, dining surfaces, and work surfaces.

SECTION 103 EQUIVALENT FACILITATION

Nothing in these requirements prevents the use of designs, products, or technologies as alternatives to those prescribed, provided they result in substantially equivalent or greater accessibility and usability. Departure from the explicit technical and scoping requirements of this Code for any element voids any otherwise applicable presumption of rebuttable evidence that the element has been constructed or altered in accordance with the minimum accessibility requirements of the ADA.

Advisory 103 Equivalent facilitation. The responsibility for demonstrating equivalent facilitation in the event of a challenge rests with the covered entity. With the exception of transit facilities, which are covered by regulations issued by the Department of Transportation, there is no process for certifying that an alternative design provides equivalent facilitation.

Equivalent Facilitation is authorized for alternate methods of providing accessibility but those alternate methods will not be afforded the "presumption."

SECTION 104 CONVENTIONS

104.1 Dimensions. Dimensions that are not stated as “maximum” or “minimum” are absolute.

104.1.1 Construction and manufacturing tolerances.

All dimensions are subject to conventional industry tolerances except where the requirement is stated as a range with specific minimum and maximum end points.

Advisory 104.1.1 Construction and manufacturing tolerances. Conventional industry tolerances recognized by this provision include those for field conditions and those that may be a necessary consequence of a particular manufacturing process. Recognized tolerances are not intended to apply to design work.

It is good practice when specifying dimensions to avoid specifying a tolerance where dimensions are absolute. For example, if this Code requires “1 inches,” avoid specifying “1 inches plus or minus X inches.”

Where the requirement states a specified range, such as in Subsection 609.4 where grab bars must be installed between 33 inches and 36 inches above the floor, the range provides an adequate tolerance and therefore no tolerance outside of the range at either end point is permitted.

Where a requirement is a minimum or a maximum dimension that does not have two specific minimum and maximum end points, tolerances may apply. Where an element is to be installed at the minimum or maximum permitted dimension, such as “15 inches minimum” or “5 pounds maximum,” it would not be good practice to specify “5 pounds (plus X pounds) or 15 inches (minus X inches).” Rather, it would be good practice to specify a dimension less than the required maximum (or more than the required minimum) by the amount of the expected field or manufacturing tolerance and not to state any tolerance in conjunction with the specified dimension.

Specifying dimensions in design in the manner described above will better ensure that facilities and elements accomplish the level of accessibility intended by these requirements. It will also more often produce an end result of strict and literal compliance with the stated requirements and eliminate enforcement difficulties and issues that might otherwise arise. Information on specific tolerances may be available from industry or trade organizations, code groups and Building Officials, and published references.

104.2 Calculation of percentages. Where the required number of elements or facilities to be provided is determined by calculations of ratios or percentages and remainders or fractions result, the next greater whole number of such elements or facilities shall be provided. Where the determination of the required size or dimension of an element or facility involves ratios or percentages, rounding down for values less than one half shall be permitted.

104.3 Figures. Unless specifically stated otherwise, figures are provided for informational purposes only.

SECTION 105 REFERENCED STANDARDS

105.1 General. The standards listed in Subsection 105.2 are incorporated by reference in this Code and are part of the requirements to the prescribed extent of each such reference. The Director of the Federal Register has approved these standards for incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of the referenced standards may be inspected at the Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW, Suite 1000, Washington, DC 20004; at the Department of Justice, Civil Rights Division, Disability Rights Section, 1425 New York Avenue, NW, Washington, DC; at the Department of Transportation, 400 Seventh Street, SW, Room 10424, Washington DC; or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.

105.2 Referenced standards. The specific edition of the standards listed below are referenced in this Code. Where differences occur between this Code and the referenced standards, this Code applies.

105.2.1 ANSI/BHMA. Copies of the referenced standards may be obtained from the Builders Hardware Manufacturers Association, 355 Lexington Avenue, 17th floor, New York, NY 10017 (<http://www.buildershardware.com>).

ANSI/BHMA A156.10—1999 *American National Standard for Power Operated Pedestrian Doors* (see Subsection 404.3).

ANSI/BHMA A156.19—1997 *American National Standard for Power Assist and Low Energy Power Operated Doors* (see Subsections 404.3, 408.3.2.1, and 409.3.1).

ANSI/BHMA A156.19—2002 *American National Standard for Power Assist and Low Energy Power Operated Doors* (see Subsections 404.3, 408.3.2.1, and 409.3.1).

Advisory 105.2.1 ANSI/BHMA. ANSI/BHMA A156.10—1999 applies to power operated doors for pedestrian use which open automatically when approached by pedestrians. Included are provisions intended to reduce the chance of user injury or entrapment.

ANSI/BHMA A156.19—1997 and A156.19—2002 applies to power assist doors, low energy power operated doors or low energy power open doors for pedestrian use not provided for in ANSI/BHMA A156.10 for Power Operated Pedestrian Doors. Included are provisions intended to reduce the chance of user injury or entrapment.

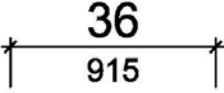
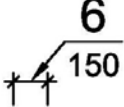
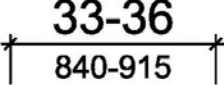




Convention	Description
	dimension showing English units (in inches unless otherwise specified) above the line and SI units (in millimeters unless otherwise specified) below the line
	dimension for small measurements
	dimension showing a range with minimum - maximum
min	minimum
max	maximum
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
-----	boundary of clear floor space or maneuvering clearance
-----⌒-----	centerline
-----	a permitted element or its extension
	direction of travel or approach
	a wall, floor, ceiling or other element cut in section or plan
	a highlighted element in elevation or plan
	location zone of element, control or feature

FIGURE 104
GRAPHIC CONVENTION FOR FIGURES

105.2.2 ASME. Copies of the referenced standards may be obtained from the American Society of Mechanical Engineers, Three Park Avenue, New York, New York 10016 (<http://www.asme.org>).

ASME A17.1—2000 *Safety Code for Elevators and Escalators*, including ASME A17.1a—2002 Addenda and ASME A17.1b—2003 Addenda (see Subsections 407.1, 408.1, 409.1, and 810.9).

ASME A18.1-1999 *Safety Standard for Platform Lifts and Stairway Chairlifts*, including ASME A18.1a—2001 Addenda and ASME A18.1b—2001 Addenda (see Subsection 410.1).

ASME A18.1—2003 *Safety Standard for Platform Lifts and Stairway Chairlifts*, (see Subsection 410.1).

Advisory 105.2.2 ASME. ASME A17.1—2000 is used by local jurisdictions throughout the United States for the design, construction, installation, operation, inspection, testing, maintenance, alteration, and repair of elevators and escalators. The majority of the requirements apply to the operational machinery not seen or used by elevator passengers. ASME A17.1 requires a two-way means of emergency communications in passenger elevators. This means of communication must connect with emergency or authorized personnel and not an automated answering system. The communication system must be push button activated. The activation button must be permanently identified with the word “HELP.” A visual indication acknowledging the establishment of a communications link to authorized personnel must be provided. The visual indication must remain on until the call is terminated by authorized personnel. The building location, the elevator car number, and the need for assistance must be provided to authorized personnel answering the emergency call. The use of a handset by the communications system is prohibited. Only the authorized personnel answering the call can terminate the call. Operating instructions for the communications system must be provided in the elevator car.

The provisions for escalators require that at least two flat steps be provided at the entrance and exit of every escalator and that steps on escalators be demarcated by yellow lines 2 inches wide maximum along the back and sides of steps.

ASME A18.1—1999 and ASME A18.1—2003 address the design, construction, installation, operation, inspection, testing, maintenance and repair of lifts that are intended for transportation of persons with disabilities. Lifts are classified as: vertical platform lifts, inclined platform lifts, inclined stairway chairlifts, private residence vertical platform lifts, private residence inclined platform lifts, and private residence inclined stairway chairlifts.

This Code does not permit the use of inclined stairway chairlifts which do not provide platforms because such lifts require the user to transfer to a seat.

ASME A18.1 contains requirements for runways, which are the spaces in which platforms or seats move. The standard includes additional provisions for runway enclosures, electrical equipment and wiring, structural support, head

room clearance (which is 80 inches minimum), lower level access ramps and pits. The enclosure walls not used for entry or exit are required to have a grab bar the full length of the wall on platform lifts. Access ramps are required to meet requirements similar to those for ramps in Chapter 4 of this Code.

Each of the lift types addressed in ASME A18.1 must meet requirements for capacity, load, speed, travel, operating devices, and control equipment. The maximum permitted height for operable parts is consistent with Section 308 of this Code. The standard also addresses attendant operation. However, Subsection 410.1 of this Code does not permit attendant operation.

105.2.3 ASTM. Copies of the referenced standards may be obtained from the American Society for Testing and Materials, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428 (<http://www.astm.org>).

ASTM F1292—99 *Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment* (see Subsection 1008.2.6.2).

ASTM F1292—04 *Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment* (see Subsection 1008.2.6.2).

ASTM F1487—01 *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use* (see Subsection 106.5).

ASTM F1951—99 *Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment* (see Subsection 1008.2.6.1).

Advisory 105.2.3 ASTM. ASTM F1292—99 and ASTM F1292—04 establish a uniform means to measure and compare characteristics of surfacing materials to determine whether materials provide a safe surface under and around playground equipment. These standards are referenced in the play areas requirements of this Code when an accessible surface is required inside a play area use zone where a fall attenuating surface is also required. The standards cover the minimum impact attenuation requirements, when tested in accordance with Test Method F355, for surface systems to be used under and around any piece of playground equipment from which a person may fall.

ASTM F1487—01 establishes a nationally recognized safety standard for public playground equipment to address injuries identified by the U.S. Consumer Product Safety Commission. It defines the use zone, which is the ground area beneath and immediately adjacent to a play structure or play equipment designed for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting a play structure or equipment. The play areas requirements in this Code reference the ASTM F1487 standard when defining accessible routes that overlap use zones requiring fall attenuating surfaces. If the use zone of a playground is not entirely surfaced with an accessible material, at least one accessible route

within the use zone must be provided from the perimeter to all accessible play structures or components within the playground.

ASTM F1951—99 establishes a uniform means to measure the characteristics of surface systems in order to provide performance specifications to select materials for use as an accessible surface under and around playground equipment. Surface materials that comply with this standard and are located in the use zone must also comply with ASTM F1292. The test methods in this standard address access for children and adults who may traverse the surfacing to aid children who are playing. When a surface is tested it must have an average work per foot value for straight propulsion and for turning less than the average work per foot values for straight propulsion and for turning, respectively, on a hard, smooth surface with a grade of 7 percent (1:14).

105.2.4 Reserved.

105.2.5 NFPA. Copies of the referenced standards may be obtained from the National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169-7471, (<http://www.nfpa.org>).

NFPA 72 *National Fire Alarm Code*, 1999 Edition (see Subsections 702.1 and 809.5.2).

NFPA 72 *National Fire Alarm Code*, 2002 Edition (see Subsections 702.1 and 809.5.2).

Advisory 105.2.5 NFPA. NFPA 72—1999 and NFPA 72—2002 address the application, installation, performance, and maintenance of protective signaling systems and their components. The NFPA 72 incorporates Underwriters Laboratory (UL) 1971 by reference. The standard specifies the characteristics of audible alarms, such as placement and sound levels. However, Section 702 of these requirements limits the volume of an audible alarm to 110 dBA, rather than the maximum 120 dBA permitted by NFPA 72—1999.

NFPA 72 specifies characteristics for visible alarms, such as flash frequency, color, intensity, placement, and synchronization. However, Section 702 of this Code requires that visual alarm appliances be permanently installed. UL 1971 specifies intensity dispersion requirements for visible alarms. In particular, NFPA 72 requires visible alarms to have a light source that is clear or white and has polar dispersion complying with UL 1971.

SECTION 106 DEFINITIONS

106.1 General. For the purpose of this Code, the terms defined in Subsection 106.5 have the indicated meaning.

106.2 Terms defined in Referenced Standards. Terms not defined in Subsection 106.5 or in regulations issued by the Department of Justice and the Department of Transportation to implement the Americans with Disabilities Act, but specifically defined in a referenced standard, shall have the specified meaning from the referenced standard unless otherwise stated.

106.3 Undefined terms. The meaning of terms not specifically defined in Subsection 106.5 or in regulations issued by

the Department of Justice and the Department of Transportation to implement the Americans with Disabilities Act or in referenced standards shall be as defined by collegiate dictionaries in the sense that the context implies.

106.4 Interchangeability. Words, terms and phrases used in the singular include the plural and those used in the plural include the singular.

106.5 Defined terms.

ACCESSIBLE. A site, building, facility, or portion thereof that complies with this part.

ACCESSIBLE MEANS OF EGRESS. A continuous and unobstructed way of egress travel from any point in a building or facility that provides an accessible route to an area of refuge, a horizontal exit, or a public way.

ADDITION. An expansion, extension, or increase in the gross floor area or height of a building or facility.

ADMINISTRATIVE AUTHORITY. A governmental agency that adopts or enforces regulations and guidelines for the design, construction, or alteration of buildings and facilities.

ALTERATION. A change to a building or facility that affects or could affect the usability of the building or facility or portion thereof. Alterations include, but are not limited to, remodeling, renovation, rehabilitation, reconstruction, historic restoration, resurfacing of circulation paths or vehicular ways, changes or rearrangement of the structural parts or elements, and changes or rearrangement in the plan configuration of walls and full-height partitions. Normal maintenance, reroofing, painting or wallpapering, asbestos removal, or changes to mechanical and electrical systems are not alterations unless they affect the usability of the building or facility.

ALTERATIONS TO AN AREA CONTAINING A PRIMARY FUNCTION. (See also, “Primary function”).

AMUSEMENT ATTRACTION. Any facility, or portion of a facility, located within an amusement park or theme park which provides amusement without the use of an amusement device. Amusement attractions include, but are not limited to, fun houses, barrels, and other attractions without seats.

AMUSEMENT RIDE. A system that moves persons through a fixed course within a defined area for the purpose of amusement.

AMUSEMENT RIDE SEAT. A seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers.

AREA OF SPORT ACTIVITY. That portion of a room or space where the play or practice of a sport occurs.

ASSEMBLY AREA. A building or facility, or portion thereof, used for the purpose of entertainment, educational or civic gatherings, or similar purposes. For the purposes of these requirements, assembly areas include, but are not limited to, classrooms, lecture halls, courtrooms, public meeting rooms, public hearing rooms, legislative chambers, motion picture houses, auditoria, theaters, playhouses, dinner theaters, concert halls, centers for the performing arts, amphitheaters, arenas, stadiums, grandstands, or convention centers.

ASSISTIVE LISTENING SYSTEM (ALS). An amplification system utilizing transmitters, receivers, and coupling devices to bypass the acoustical space between a sound source and a listener by means of induction loop, radio frequency, infrared, or direct-wired equipment.

BOARDING PIER. A portion of a pier where a boat is temporarily secured for the purpose of embarking or disembarking.

BOAT LAUNCH RAMP. A sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.

BOAT SLIP. That portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy.

CATCH POOL. A pool or designated section of a pool used as a terminus for water slide flumes.

CHARACTERS. Letters, numbers, punctuation marks and typographic symbols.

CHILDREN'S USE. Describes spaces and elements specifically designed for use primarily by people 12 years old and younger.

CIRCULATION PATH. An exterior or interior way of passage provided for pedestrian travel, including but not limited to, walks, hallways, courtyards, elevators, platform lifts, ramps, stairways, and landings.

CLOSED-CIRCUIT TELEPHONE. A telephone with a dedicated line such as a house phone, courtesy phone or phone that must be used to gain entry to a facility.

COMMERCE. Travel, trade, traffic, commerce, transportation, or communication:

1. Among the several states;
2. Between any foreign country or any territory or possession and any state; or
3. Between points in the same state but through another state or foreign country.

COMMERCIAL FACILITIES. Facilities:

1. Whose operations will affect commerce;
2. That are intended for nonresidential use by a private entity; and
3. That are not:
 - (a) Facilities that are covered or expressly exempted from coverage under the Fair Housing Act of 1968, as amended (42 U.S.C. 3601-3631);
 - (b) Aircraft; or
 - (c) Railroad locomotives, railroad freight cars, railroad cabooses, commuter or intercity passenger rail cars (including coaches, dining cars, sleeping cars, lounge cars, and food service cars), and any other railroad cars described in Section 242 of the ADA or covered under Title II of the ADA, or rail-

road rights-of-way. For purposes of this definition, "rail" and "railroad" have the meaning given the term "railroad" in Section 202(e) of the Federal Railroad Safety Act of 1970 [45 U.S.C. 431(e)].

COMMON USE. Interior or exterior circulation paths, rooms, spaces, or elements that are not for public use and are made available for the shared use of two or more people.

CROSS SLOPE. The slope that is perpendicular to the direction of travel (see running slope).

CURB RAMP. A short ramp cutting through a curb or built up to it.

DESIGNATED PUBLIC TRANSPORTATION. Transportation provided by a public entity (other than public school transportation) by bus, rail, or other conveyance (other than transportation by aircraft or inter-city or commuter rail transportation) that provides the general public with general or special service, including charter service, on a regular and continuing basis.

DETECTABLE WARNING. A standardized surface feature built in or applied to walking surfaces or other elements to warn of hazards on a circulation path.

DISABILITY. With respect to an individual, a physical or mental impairment that substantially limits one or more of the major life activities of such individual; a record of such an impairment; or being regarded as having such an impairment.

1. The phrase physical or mental impairment means:

- (a) Any physiological disorder or condition, cosmetic disfigurement, or an anatomical loss affecting one or more of the following body systems; neurological; musculoskeletal; special sense organs; respiratory, including speech organs; cardiovascular; reproductive; digestive; genitourinary; hemic and lymphatic; skin; and endocrine;
- (b) Any mental or psychological disorder such as mental retardation, organic brain syndrome, emotional or mental illness, and specific learning disabilities;
- (c) The phrase physical or mental impairment includes, but is not limited to, such contagious and noncontagious diseases and conditions as orthopedic, visual, speech, and hearing impairments, cerebral palsy, epilepsy, muscular dystrophy, multiple sclerosis, cancer, heart disease, diabetes, mental retardation, emotional illness, specific learning disabilities, HIV disease (whether symptomatic or asymptomatic), tuberculosis, drug addiction, and alcoholism;
- (d) The phrase physical or mental impairment does not include homosexuality or bisexuality.

2. The phrase major life activities means functions such as caring for one's self, performing manual tasks, walking, seeing, hearing, speaking, breathing, learning and working.

3. The phrase has a record of such an impairment means has a history of, or has been misclassified as having, a mental or physical impairment that substantially limits one or more major life activities.
4. The phrase is regarded as having an impairment means:
 - (a) Has a physical or mental impairment that does not substantially limit major life activities but that is treated by a private entity as constituting such a limitation;
 - (b) Has a physical or mental impairment that substantially limits major life activities only as a result of the attitudes of others toward such impairment; or
 - (c) Has none of the impairments defined in paragraph (1) of this definition but is treated by a private entity as having such an impairment.
5. The term “disability” does not include:
 - (a) Transvestism, transsexualism, pedophilia, exhibitionism, voyeurism, gender identity disorders not resulting from physical impairments, or other sexual behavior disorders;
 - (b) Compulsive gambling, kleptomania or pyromania; or
 - (c) Psychoactive substance use disorders resulting from current illegal use of drugs.

ELEMENT. An architectural or mechanical component of a building, facility, space, or site.

ELEVATED PLAY COMPONENT. A play component that is approached above or below grade and that is part of a composite play structure consisting of two or more play components attached or functionally linked to create an integrated unit providing more than one play activity.

EMPLOYEE WORK AREA. All or any portion of a space used only by employees and used only for work. Corridors, toilet rooms, kitchenettes and break rooms are not employee work areas.

ENTRANCE. Any access point to a building or portion of a building or facility used for the purpose of entering. An entrance includes the approach walk, the vertical access leading to the entrance platform, the entrance platform itself, vestibule if provided, the entry door or gate, and the hardware of the entry door or gate.

EXISTING FACILITY. A facility in existence on any given date, without regard to whether the facility may also be considered newly constructed or altered under this Code.

FACILITY. All or any portion of buildings, structures, site improvements, elements, and pedestrian routes or vehicular ways located on a site.

GANGWAY. A variable-sloped pedestrian walkway that links a fixed structure or land with a floating structure. Gangways that connect to vessels are not addressed by this Code.

GOLF CAR PASSAGE. A continuous passage on which a motorized golf car can operate.

GROUND LEVEL PLAY COMPONENT. A play component that is approached and exited at the ground level.

HOUSING AT A PLACE OF EDUCATION. Housing operated by or on behalf of an elementary, secondary, undergraduate, or postgraduate school, or other place of education, including dormitories, suites, apartments, or other places of residence.

KEY STATION. Rapid and light rail stations, and commuter rail stations, as defined under criteria established by the Department of Transportation in 49 CFR 37.47 and 49 CFR 37.51, respectively.

MAIL BOXES. Receptacles for the receipt of documents, packages, or other deliverable matter. Mail boxes include, but are not limited to, post office boxes and receptacles provided by commercial mail-receiving agencies, apartment facilities, or schools.

MARKED CROSSING. A crosswalk or other identified path intended for pedestrian use in crossing a vehicular way.

MAXIMUM EXTENT FEASIBLE. The phrase “to the maximum extent feasible,” as used in this Code, applies to the case where the nature of an existing facility makes it virtually impossible to comply fully with applicable accessibility standards through a planned alteration. In these circumstances, the alteration shall provide the maximum physical accessibility feasible. Any altered features of the facility that can be made accessible shall be made accessible. If providing accessibility in conformance with this Section to individuals with certain disabilities (e.g., those who use wheelchairs) would not be feasible, the facility shall be made accessible to persons with other types of disabilities (e.g., those who use crutches, those who have impaired vision or hearing, or those who have other impairments).

MEZZANINE. An intermediate level or levels between the floor and ceiling of any story with an aggregate floor area of not more than one-third of the area of the room or space in which the level or levels are located. Mezzanines have sufficient elevation that space for human occupancy can be provided on the floor below.

OCCUPANT LOAD. The number of persons for which the means of egress of a building or portion of a building is designed.

OPERABLE PART. A component of an element used to insert or withdraw objects, or to activate, deactivate, or adjust the element.

PATH OF TRAVEL.

1. A *path of travel* includes a continuous, unobstructed way of pedestrian passage by means of which the altered area may be approached, entered, and exited, and which connects the altered area with an exterior approach (including sidewalks, streets, and parking areas), an *entrance* to the *facility*, and other parts of the *facility*.
2. An *accessible path of travel* may consist of *walks* and *sidewalks*, *curb ramps* and other interior or exterior pedestrian *ramps*; clear floor paths through lobbies,

corridors, rooms, and other improved areas; parking access aisles; elevators and lifts; or a combination of these *elements*. In transportation *facilities* covered by 49 CFR 37, an *accessible path of travel* may include *walks* and sidewalks, *curb ramps* and other interior or exterior pedestrian *ramps*, clear floor paths through corridors, waiting areas, concourses, and other improved areas, parking access aisles, elevators and lifts, bridges, tunnels, or other passageways between platforms, or a combination of these and other *elements*.

3. For the purposes of this Code, the term “*path of travel*” also includes the restrooms, telephones, and drinking fountains serving the altered area.

PICTOGRAM. A pictorial symbol that represents activities, facilities, or concepts.

PLACES OF LODGING. See “Place of public accommodation.”

PLACE OF PUBLIC ACCOMMODATION. A facility, operated by a private entity, whose operations affect commerce and fall within at least one of the following categories:

1. **Places of lodging.** Except for an establishment located within a *facility* that contains not more than five rooms for rent or hire and that actually is occupied by the proprietor of the establishment as the residence of the proprietor. For purposes of this part, a facility is a “place of lodging” if it is:
 - (a) An inn, hotel, or motel; or
 - (b) A facility that—
 - (i) Provides guestrooms for sleeping for stays that primarily are short-term in nature (generally 30 days or less) where the occupant does not have the right to return to a specific room or unit after the conclusion of his or her stay; and
 - (ii) Provides guestrooms under conditions and with amenities similar to a hotel, motel, or inn, including the following:
 - (1) On- or off-site management and reservations service;
 - (2) Rooms available on a walk-up or call-in basis;
 - (3) Availability of housekeeping or linen service; and
 - (4) Acceptance of reservations for a guestroom type without guaranteeing a particular unit or room until check-in, and without a prior lease or security deposit.

Resort condominiums are considered to be public lodging establishments pursuant to Section 509.242, F.S.;

2. **Establishments serving food and drink.** A restaurant, bar, or other establishment serving food or drink;

3. **Places of exhibition or entertainment.** A motion picture house, theater, concert hall, stadium, or other place of exhibition or entertainment;
4. **Places of public gathering.** An auditorium, convention center, lecture hall, or other place of public gathering;
5. **Sales or rental establishments.** A bakery, grocery store, clothing store, hardware store, shopping center, or other sales or rental establishment;
6. **Service establishments.** A laundromat, dry-cleaner, bank, barber shop, beauty shop, travel service, shoe repair service, funeral parlor, gas station, office of an accountant or lawyer, pharmacy, insurance office, professional office of a health care provider, hospital, or other service establishment;
7. **Stations used for specified public transportation.** A terminal, depot, or other station used for specified public transportation;
8. **Places of public display or collection.** A museum, library, gallery, or other place of public display or collection;
9. **Places of recreation.** A park, zoo, amusement park, or other place of recreation;
10. **Places of education.** A nursery, elementary, secondary, undergraduate, or postgraduate private school, or other place of education;
11. **Social service center establishments.** A day care center, senior citizen center, homeless shelter, food bank, adoption agency, or other social service center establishment;
12. **Places of exercise or recreation.** A gymnasium, health spa, bowling alley, golf course, or other place of exercise or recreation;

PRIMARY FUNCTION. A major activity for which the facility is intended. Areas that contain a primary function include, but are not limited to, the customer services lobby of a bank, the dining area of a cafeteria, the meeting rooms in a conference center, as well as offices and other work areas in which the activities of the public entity, public accommodation or other private entity using the facility are carried out. Mechanical rooms, boiler rooms, supply storage rooms, employee lounges or locker rooms, janitorial closets, entrances, and corridors are not areas containing a primary function. Restrooms are not areas containing a primary function unless the provision of restrooms is a primary purpose of the area, e.g., in highway rest stops. Areas of transportation facilities that involve primary functions include, but are not necessarily limited to, ticket purchase and collection areas, passenger waiting areas, train or bus platforms, baggage checking and return areas and employment areas (except those involving nonoccupiable spaces accessed only by ladders, catwalks, crawl spaces, very narrow passageways, or freight (nonpassenger) elevators which are frequented only by repair personnel).

PLAY AREA. A portion of a site containing play components designed and constructed for children.

PLAY COMPONENT. An element intended to generate specific opportunities for play, socialization, or learning. Play

components are manufactured or natural; and are stand-alone or part of a composite play structure.

PRIVATE BUILDING OR FACILITY. A place of public accommodation or a commercial building or facility subject to title III of the ADA and 28 CFR part 36 or a transportation building or facility subject to title III of the ADA and 49 CFR 37.45.

PRIVATE CLUB. A private club or establishment exempted from coverage under title II of the Civil Rights Act of 1964 [42 U.S.C. 2000a(e)].

PRIVATE ENTITY. A person or entity other than a public entity.

PROFESSIONAL OFFICE OF A HEALTH CARE PROVIDER. A location where a person or entity, regulated by a State to provide professional services related to the physical or mental health of an individual, makes such services available to the public. The facility housing the “professional office of a health care provider” only includes floor levels housing at least one health care provider, or any floor level designed or intended for use by at least one health care provider.

PUBLIC ACCOMMODATION. A private entity that owns, leases (or leases to), or operates a place of public accommodation.

PUBLIC BUILDING OR FACILITY. A building or facility or portion of a building or facility designed, constructed, or altered by, on behalf of, or for the use of a public entity subject to title II of the ADA and 28 CFR part 35 or to title II of the ADA and 49 CFR 37.41 or 37.43.

PUBLIC ENTITY.

1. Any State or local government;
2. Any department, agency, special purpose district, or other instrumentality of a State or States or local government; and
3. The National Railroad Passenger Corporation, and any commuter authority (as defined in section 103(8) of the Rail Passenger Service Act). (45 U.S.C. 541)

PUBLIC ENTRANCE. An entrance that is not a service entrance or a restricted entrance.

PUBLIC USE. Interior or exterior rooms, spaces, or elements that are made available to the public. Public use may be provided at a building or facility that is privately or publicly owned.

PUBLIC WAY. Any street, alley or other parcel of land open to the outside air leading to a public street, which has been deeded, dedicated or otherwise permanently appropriated to the public for public use and which has a clear width and height of not less than 10 feet.

QUALIFIED HISTORIC BUILDING OR FACILITY. A building or facility that is listed in or eligible for listing in the National Register of Historic Places, or designated as historic under an appropriate State or local law.

RAMP. A walking surface that has a running slope steeper than 1:20.

READILY ACHIEVABLE. Easily accomplishable and able to be carried out without much difficulty or expense.

RESIDENTIAL DWELLING UNIT. A unit intended to be used as a residence, that is primarily long-term in nature. Residential dwelling units do not include transient lodging, inpatient medical care, licensed long-term care, and detention or correctional facilities.

RESORT CONDOMINIUM. (Section 509.242, F.S.). A resort condominium is any unit or group of units in a condominium, cooperative, or time-share plan which is rented more than three times a calendar year for periods of less than 30 days or one calendar month, whichever is less, or which is advertised or held out to the public as a place regularly rented for periods of less than 30 days or one calendar month, whichever is less (see also, “Places of lodging”).

RESTRICTED ENTRANCE. An entrance that is made available for common use on a controlled basis but not public use and that is not a service entrance.

RUNNING SLOPE. The slope that is parallel to the direction of travel (see “Cross slope”).

SELF-SERVICE STORAGE. Building or facility designed and used for the purpose of renting or leasing individual storage spaces to customers for the purpose of storing and removing personal property on a self-service basis.

SERVICE ENTRANCE. An entrance intended primarily for delivery of goods or services.

SHOPPING CENTER OR SHOPPING MALL.

1. A building housing five or more sales or rental establishments; or
2. A series of buildings on a common site, either under common ownership or common control or developed either as one project or as a series of related projects, housing five or more sales or rental establishments. For purposes of this Section, Places of Public Accommodation of the types listed in Paragraph (5) of the definition of “Place of public accommodation” in this Code are considered sales or rental establishments. The facility housing a “shopping center or shopping mall” only includes floor levels housing at least one sales or rental establishment, or any floor level designed or intended for use by at least one sales or rental establishment.

SITE. A parcel of land bounded by a property line or a designated portion of a public right-of-way.

SOFT CONTAINED PLAY STRUCTURE. A play structure made up of one or more play components where the user enters a fully enclosed play environment that utilizes pliable materials, such as plastic, netting, or fabric.

SPACE. A definable area, such as a room, toilet room, hall, assembly area, entrance, storage room, alcove, courtyard, or lobby.

SPECIFIED PUBLIC TRANSPORTATION. Transportation by bus, rail, or any other conveyance (other than aircraft) provided by a private entity to the general public, with general or special service (including charter service) on a regular and continuing basis.

STORY. That portion of a building or facility designed for human occupancy included between the upper surface of a floor and upper surface of the floor or roof next above. A story containing one or more mezzanines has more than one floor level.

STRUCTURAL FRAME. The columns and the girders, beams, and trusses having direct connections to the columns and all other members that are essential to the stability of the building or facility as a whole.

TACTILE. An object that can be perceived using the sense of touch.

TECHNICALLY INFEASIBLE. With respect to an alteration of a building or a facility, something that has little likelihood of being accomplished because existing structural conditions would require removing or altering a load-bearing member that is an essential part of the structural frame; or because other existing physical or site constraints prohibit modification or addition of elements, spaces, or features that are in full and strict compliance with the minimum requirements.

TEEING GROUND. In golf, the starting place for the hole to be played.

THEME PARK OR ENTERTAINMENT COMPLEX. (Section 509.0013(9), F.S.). Theme park or entertainment complex means a complex comprised of at least 25 contiguous acres owned and controlled by the same business entity and which contains permanent exhibitions and a variety of recreational activities and has a minimum of 1 million visitors annually.

TRANSFER DEVICE. Equipment designed to facilitate the transfer of a person from a wheelchair or other mobility aid to and from an amusement ride seat.

TRANSIENT LODGING. A building or facility containing one or more guestroom(s) for sleeping that provides accommodations that are primarily short-term in nature. Transient lodging does not include residential dwelling units intended to be used as a residence, inpatient medical care facilities, licensed long-term care facilities, detention or correctional facilities, or private buildings or facilities that contain not more than five rooms for rent or hire and that are actually occupied by the proprietor as the residence of such proprietor.

TRANSITION PLATE. A sloping pedestrian walking surface located at the end(s) of a gangway.

TTY. An abbreviation for teletypewriter. Machinery that employs interactive text-based communication through the transmission of coded signals across the telephone network. TTYs may include, for example, devices known as TDDs (telecommunication display devices or telecommunication devices for deaf persons) or computers with special modems. TTYs are also called text telephones.

USE ZONE. The ground level area beneath and immediately adjacent to a play structure or play equipment that is designated by ASTM F1487 (incorporated by reference, see “Referenced Standards” in Chapter 1) for unrestricted circulation around the play equipment and where it is predicted that a user would land when falling from or exiting the play equipment.

VEHICULAR WAY. A route provided for vehicular traffic, such as in a street, driveway, or parking facility.

WALK. An exterior prepared surface for pedestrian use, including pedestrian areas such as plazas and courts.

WHEELCHAIR. A manually-operated or power-driven device designed primarily for use by an individual with a mobility disability for the main purpose of indoor or of both indoor and outdoor locomotion. This definition does not apply to Federal wilderness areas; wheelchairs in such areas are defined in Section 508(c)(2) of the ADA, 42 U.S.C. 12207(c)(2).

WHEELCHAIR SPACE. Space for a single wheelchair and its occupant.

WORK AREA EQUIPMENT. Any machine, instrument, engine, motor, pump, conveyor, or other apparatus used to perform work. As used in this Code, this term shall apply only to equipment that is permanently installed or built-in in employee work areas. Work area equipment does not include passenger elevators and other accessible means of vertical transportation.

CHAPTER 2

SCOPING REQUIREMENTS

SECTION 201 APPLICATION

201.1 Scope. This Code establishes standards for accessibility to places of public accommodation and commercial facilities by individuals with disabilities. This Code shall also apply: to state and local government facilities pursuant to Section 553.503, F.S.; to private clubs pursuant to Section 553.505, F.S.; and to residential buildings pursuant to Section 553.504(2), F.S., and the *ADA Standards for Accessible Design*. All new or altered public buildings and facilities, private buildings and facilities, places of public accommodation and commercial facilities subject to this Code shall comply with this Code.

This Code applies to: All areas of newly designed and newly constructed buildings and facilities as determined by the *ADA Standards for Accessible Design*; portions of altered buildings and facilities as determined by the *ADA Standards for Accessible Design*; a building or facility that is being converted from residential to nonresidential or mixed use as defined by the *EPCOT Building Code* where such building or facility must, at a minimum, comply with Section 553.508, F.S., and the requirements for alterations as determined by the *ADA Standards for Accessible Design*; buildings and facilities where the original construction or any former alteration or renovation was carried out in violation of applicable permitting law.

Advisory 201.1 Scope. These requirements are to be applied to all areas of a facility unless exempted, or where scoping limits the number of multiple elements required to be accessible. For example, not all medical care patient rooms are required to be accessible; those that are not required to be accessible are not required to comply with these requirements. However, common use and public use spaces such as recovery rooms, examination rooms, and cafeterias are not exempt from these requirements and must be accessible.

Florida vertical accessibility requires all levels in all new buildings, structures and facilities and all altered areas of existing buildings, structures and facilities to be accessible to persons with disabilities. All new and altered areas must comply with the *ADA Standards for Accessible Design* including requirements for accessible routes. Where the *ADA Standards* do not require an accessible route to each and every level, the Florida requirement may be waived down to the requirement of the *ADA Standards*.

201.1.1 Vertical accessibility. Sections 553.501-553.513, F.S., and the *ADA Standards for Accessible Design* do not relieve the owner of any building, structure or facility governed by those sections from the duty to provide vertical accessibility to all levels above and below the occupiable grade level regardless of whether the Standards require an

elevator to be installed in such building, structure or facility, except for:

1. Elevator pits, elevator penthouses, mechanical rooms, piping or equipment catwalks and automobile lubrication and maintenance pits and platforms.
2. Unoccupiable spaces, such as rooms, enclosed spaces and storage spaces that are not designed for human occupancy, for public accommodations or for work areas.
3. Occupiable spaces and rooms that are not open to the public and that house no more than five persons, including, but not limited to equipment control rooms and projection booths.
4. Theaters, concert halls, and stadiums, or other large assembly areas that have stadium-style seating or tiered seating if Sections 221 and 802 are met.
5. All play and recreation areas if the requirements of chapter 10 are met.
6. All employee areas as exempted by Subsection 203.9.
7. Facilities, sites and spaces exempted by Section 203.

Buildings, structures and facilities must, at a minimum, comply with the requirements of the *ADA Standards for Accessible Design*.

201.2 Application based on building or facility use. Where a site, building, facility, room, or space contains more than one use, each portion shall comply with the applicable requirements for that use.

201.2.1 Commercial facilities and places of public accommodation located in private residences.

201.2.1.1 When a commercial facility or place of public accommodation is located in a private residence, the portion of the residence used exclusively as a residence is not covered by this Subsection, but that portion used exclusively in the operation of the commercial facility or that portion used both for the commercial facility and for residential purposes is covered by the new construction and alterations requirements of this Subsection.

201.2.2.2 The portion of the residence covered under Subsection 201.2.1.1 extends to those elements used to enter the commercial facility, including the homeowner's front sidewalk, if any, the door or entryway, and hallways; and those portions of the residence, interior or exterior, available to or used by employees or visitors or customers and clients of the commercial facility, including restrooms.

201.3 Temporary and permanent structures. These requirements shall apply to temporary and permanent buildings and facilities.

Advisory 201.3 Temporary and permanent structures.

Temporary buildings or facilities covered by these requirements include, but are not limited to, reviewing stands, temporary classrooms, bleacher areas, stages, platforms and daises, fixed furniture systems, wall systems, and exhibit areas, temporary banking facilities, and temporary health screening facilities. Structures and equipment directly associated with the actual processes of construction are not required to be accessible as permitted in Subsection 203.2.

201.4 Scope of Coverage. This Code applies to fixed or built-in elements of buildings, structures, site improvements and pedestrian routes or vehicular ways located on a site. Unless specifically stated otherwise, advisory notes, appendix notes and figures contained in this Code explain or illustrate the requirements; they do not establish enforceable requirements.

SECTION 202 EXISTING BUILDINGS AND FACILITIES

202.1 General. Additions and alterations to existing buildings or facilities shall comply with this Section.

202.2 Additions. Each addition to an existing building or facility shall comply with the requirements for new construction. Each addition that affects or could affect the usability of or access to an area containing a primary function shall comply with Subsection 202.4.

202.3 Alterations. Where existing elements or spaces or common areas are altered, each altered element, space or area shall comply with the applicable requirements of this Chapter and Subsection 201.1.1. See Subsection 208.1 for existing parking.

Exceptions:

1. Unless required by Subsection 202.4, where elements or spaces are altered and the circulation path to the altered element or space is not altered, an accessible route shall not be required.
2. In alterations, where compliance with applicable requirements is technically infeasible, the alteration shall comply with the requirements to the maximum extent feasible.
3. Residential dwelling units not required to be accessible in compliance with a standard issued pursuant to the Americans with Disabilities Act or Section 504 of the Rehabilitation Act of 1973, as amended, shall not be required to comply with this Subsection.

Advisory 202.3 Alterations. Although covered entities are permitted to limit the scope of an alteration to individual elements, the alteration of multiple elements within a room or space may provide a cost-effective opportunity to make the entire room or space accessible. Any elements or spaces of the building or facility that are required to comply with these requirements must be made accessible within the scope of the alteration, to the maximum extent feasible. If providing accessibility in compliance with these requirements for people with one type of disability (e.g., people who use wheelchairs) is not feasible, accessibility must still

be provided in compliance with the requirements for people with other types of disabilities (e.g., people who have hearing impairments or who have vision impairments) to the extent that such accessibility is feasible.

Florida requirements for existing parking Section 553.5041(g), F.S., and vertical accessibility Section 553.509, F.S., are incorporated into this general section applicable to alterations. Florida requirements may be waived down to the ADA Standards requirements.

202.3.1 Prohibited reduction in access. An alteration that decreases or has the effect of decreasing the accessibility of a building or facility below the requirements for new construction at the time of the alteration is prohibited.

Advisory 202.3.1 Prohibited reduction in access. Department of Justice regulations 28 CFR 35.133 for public entities (Title II) and 28 CFR 36.211 for private entities (Title III) clarify that reduction of accessibility is benchmarked to the 2010 ADA *Standards for Accessible Design* as adopted by this Code. Those regulations state: "If the 2010 Standards reduce the technical requirements or the number of required accessible elements below the number required by the 1991 Standards, the technical requirements or the number of accessible elements in a facility subject to this part may be reduced in accordance with the requirements of the 2010 Standards."

202.3.2 Extent of application. An alteration of an existing element, space, or area of a building or facility shall not impose a requirement for accessibility greater than required for new construction.

202.3.3 Barriers at common or emergency entrances and exits. Barriers at common or emergency entrances and exits of business establishments conducting business with the general public that are existing, under construction, or under contract for construction which would prevent a person from using such entrances or exits shall be removed.

202.4 Alterations affecting primary function areas. In addition to the requirements of Subsection 202.3, an alteration that affects or could affect the usability of or access to an area containing a primary function shall be made so as to ensure that, to the maximum extent feasible, the path of travel to the altered area, including the rest rooms, telephones, and drinking fountains serving the altered area, are readily accessible to and usable by individuals with disabilities, unless such alterations are disproportionate to the overall alterations in terms of cost pursuant to Subsection 202.4.1. Alterations to windows, hardware, controls, electrical outlets, and signage shall not be deemed to be alterations that affect the usability of or access to an area containing a primary function.

Exceptions:

1. Residential dwelling units shall not be required to comply with this Subsection.
2. If a private entity has constructed or altered required elements of a path of travel at a place of public accommodation or commercial facility in

accordance with the specifications in the 2002 edition of this Code, the private entity is not required to retrofit such elements to reflect incremental changes in the proposed standards solely because of an alteration to a primary function area served by that path of travel.

3. The path of travel requirements shall not apply to measures taken solely to comply with barrier removal requirements.
4. If a public entity has constructed or altered required elements of a path of travel in accordance with the specifications in either the 2002 edition of this Code or the *Uniform Federal Accessibility Standards*, as an equivalent facilitation, before March 15, 2012, the public entity is not required to retrofit such elements to reflect incremental changes in this Code solely because of an alteration to a primary function area served by that path of travel.
5. The path of travel requirement shall not apply to alterations undertaken solely for purposes of meeting the public entity program accessibility requirements of Section 35.150, 28 CFR 35.
6. If a tenant is making alterations that would trigger the requirements of this Section, those alterations by the tenant in areas that only the tenant occupies do not trigger a path of travel obligation upon the landlord with respect to areas of the facility under the landlord's authority, if those areas are not otherwise being altered.

In existing transportation facilities, an area of primary function shall be as defined under regulations published by the Secretary of the Department of Transportation or the Attorney General (see definition of "Primary function").

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

Advisory 202.4 Alterations affecting primary function areas.

An area of a building or facility containing a major activity for which the building or facility is intended is a primary function area. Department of Justice ADA regulations state, "Alterations made to provide an accessible path of travel to the altered area will be deemed disproportionate to the overall alteration when the cost exceeds 20 percent of the cost of the alteration to the primary function area." (28 CFR 36.403 (f)(1)). See also Department of Transportation ADA regulations, which use similar concepts in the context of public sector transportation facilities (49 CFR 37.43 (e)(1)).

There can be multiple areas containing a primary function in a single building. Primary function areas are not limited to public use areas. For example, both a bank lobby and the bank's employee areas such as the teller areas and walk-in safe are primary function areas.

Also, mixed use facilities may include numerous primary function areas for each use. Areas containing a primary function do not include: mechanical rooms, boiler rooms, supply

storage rooms, employee lounges or locker rooms, janitorial closets, entrances, corridors, or restrooms.

DOJ regulation 28 CFR 36.403(c) gives the following examples of alterations that effect the usability of or access to an area containing a primary function. Such areas include but are not limited to: remodeling merchandise display areas or employee work areas in a department store; replacing an inaccessible floor surface in the customer service or employee work areas of a bank; redesigning the assembly line area of a factory; or, installing a computer center in an accounting firm.

Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1 of the Code, apply to the path of travel upgrades required by this Subsection. Florida requirements may be waived down to the ADA Standards requirements.

202.4.1 Disproportionate cost. Alterations made to provide an accessible path of travel to the altered area will be deemed disproportionate to the overall alteration when the cost exceeds 20 percent of the cost of the alteration to the primary function area. Costs that may be counted as expenditures required to provide an accessible path of travel may include: (i) costs associated with providing an accessible entrance and an accessible route to the altered area; (ii) costs associated with making restrooms accessible, such as installing grab bars, enlarging toilet stalls, insulating pipes, or installing accessible faucet controls; (iii) costs associated with providing accessible telephones, such as relocating the telephone to an accessible height, installing amplification devices, or installing a text telephone (TTY); (iv) costs associated with relocating an inaccessible drinking fountain.

202.4.2 Accessible features in the event of disproportionality. When the cost of alterations necessary to make the path of travel to the altered area fully accessible is disproportionate to the cost of the overall alteration, the path of travel shall be made accessible to the extent that it can be made accessible without incurring disproportionate costs. In choosing which accessible elements to provide, priority should be given to those elements that will provide the greatest access, in the following order: (i) an accessible entrance; (ii) an accessible route to the altered area; (iii) at least one accessible restroom for each sex or a single unisex restroom; (iv) accessible telephones; (v) accessible drinking fountains; and (vi) when possible, additional accessible elements such as parking, storage, and alarms.

202.4.3 Series of smaller alterations. The obligation to provide an accessible path of travel may not be evaded by performing a series of small alterations to the area served by a single path of travel if those alterations could have been performed as a single undertaking.

202.4.3.1 If an area containing a primary function has been altered without providing an accessible path of travel to that area, and subsequent alterations of that area, or a different area on the same path of travel, are undertaken within three years of the original alteration,

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the total cost of alterations to the primary function areas on that path of travel during the preceding three year period shall be considered in determining whether the cost of making that path of travel accessible is disproportionate.

202.4.3.2 Only alterations undertaken after January 26, 1992, shall be considered in determining if the cost of providing an accessible path of travel is disproportionate to the overall cost of the alterations.

202.5 Alterations to qualified historic buildings and facilities. Alterations to a qualified historic building or facility shall comply with Subsections 202.3 and 202.4 to the maximum extent feasible.

Exception: Where the State Historic Preservation Officer or Advisory Council on Historic Preservation determines that compliance with the requirements for accessible routes, entrances, or toilet facilities would threaten or destroy the historic significance of the building or facility, the exceptions for alterations to qualified historic buildings or facilities for that element shall be permitted to apply.

Advisory 202.5 Alterations to qualified historic buildings and facilities exception.

State Historic Preservation Officers are State appointed officials who carry out certain responsibilities under the National Historic Preservation Act. State Historic Preservation Officers consult with Federal and State agencies, local governments, and private entities on providing access and protecting significant elements of qualified historic buildings and facilities. There are exceptions for alterations to qualified historic buildings and facilities for accessible routes (see Subsection 206.2.1, Exception 1 and Subsection 206.2.3, Exception 7); entrances (see Subsection 206.4, Exception 2); and toilet facilities (see Subsection 213.2, Exception 2). When an entity believes that compliance with the requirements for any of these elements would threaten or destroy the historic significance of the building or facility, the entity should consult with the State Historic Preservation Officer. If the State Historic Preservation Officer agrees that compliance with the requirements for a specific element would threaten or destroy the historic significance of the building or facility, use of the exception is permitted. Public entities have an additional obligation to achieve program accessibility under the Department of Justice ADA regulations. See 28 CFR 35.150. These regulations require public entities that operate historic preservation programs to give priority to methods that provide physical access to individuals with disabilities. If alterations to a qualified historic building or facility to achieve program accessibility would threaten or destroy the historic significance of the building or facility, fundamentally alter the program, or result in undue financial or administrative burdens, the Department of Justice ADA regulations allow alternative methods to be used to achieve program accessibility. In the case of historic preservation programs, such as an historic house museum, alternative methods include using audio-visual materials to depict portions of the house that cannot otherwise be made accessible. In the case of other qualified historic properties, such as an historic government office building, alternative methods

include relocating programs and services to accessible locations. The Department of Justice ADA regulations also allow public entities to use alternative methods when altering qualified historic buildings or facilities in the rare situations where the State Historic Preservation Officer determines that it is not feasible to provide physical access using the exceptions permitted in this Subsection without threatening or destroying the historic significance of the building or facility. See 28 CFR 35.151(d).

The Accessibility Office at the National Endowment for the Arts (NEA) provides a variety of resources for museum operators and historic properties including: the Design for Accessibility Guide and the Disability Symbols. Contact NEA about these and other resources at 202-682-5532 or www.arts.gov.

202.6 Architectural barrier removal. Removal of architectural barriers, pursuant to 28 C.F.R. s.36.304, from buildings, structures or facilities shall comply with this Code's requirements for alterations unless compliance would render the removal not readily achievable. In no instance shall the removal of an architectural barrier create a significant risk to the health or safety of an individual with a disability or others.

202.6.1 Measures taken to comply with federal barrier removal requirements shall comply with the applicable requirements for alterations for the element being altered.

Exception:

1. The path of travel requirements of Subsection 202.4 shall not apply to measures taken solely to comply with federal architectural barrier removal requirements.
2. If the measures required to remove a barrier would not be readily achievable, a public accommodation may take other readily achievable measures to remove the barrier that do not fully comply with the specified requirements. Such measures include but are not limited to providing a ramp with a steeper slope or widening a doorway to a narrower width than that mandated by the alterations requirements. No measure shall be taken that poses a significant risk to the health or safety of individuals with disabilities or others.

SECTION 203 GENERAL EXCEPTIONS

203.1 General. Sites, buildings, facilities, and elements are exempt from these requirements to the extent specified by this Section.

203.2 Construction sites. Structures and sites directly associated with the actual processes of construction, including but not limited to, scaffolding, bridging, materials hoists, materials storage, and construction trailers shall not be required to comply with these requirements or to be on an accessible route. Portable toilet units provided for use exclusively by construction personnel on a construction site shall not be required to comply with Section 213 or to be on an accessible route.

203.3 Raised areas. Areas raised primarily for purposes of security, life safety, or fire safety, including but not limited to, observation or lookout galleries, prison guard towers, fire towers, or life guard stands shall not be required to comply with these requirements or to be on an accessible route.

203.4 Limited access spaces. Spaces accessed only by ladders, catwalks, crawl spaces, or very narrow passageways shall not be required to comply with these requirements or to be on an accessible route.

203.5 Machinery spaces. Spaces frequented only by service personnel for maintenance, repair, or occasional monitoring of equipment shall not be required to comply with these requirements or to be on an accessible route. Machinery spaces include, but are not limited to, elevator pits or elevator penthouses; mechanical, electrical or communications equipment rooms; piping or equipment catwalks; water or sewage treatment pump rooms and stations; electric substations and transformer vaults; and highway and tunnel utility facilities.

203.6 Single occupant structures. Single occupant structures accessed only by passageways below grade or elevated above standard curb height, including but not limited to, toll booths that are accessed only by underground tunnels, shall not be required to comply with these requirements or to be on an accessible route.

203.7 Detention and correctional facilities. In detention and correctional facilities, common use areas that are used only by inmates or detainees and security personnel and that do not serve holding cells or housing cells required to comply with Section 232, shall not be required to comply with these requirements or to be on an accessible route.

203.8 Residential facilities. In residential facilities, common use areas that do not serve residential dwelling units required to provide mobility features complying with Subsections 809.2 through 809.4 shall not be required to comply with these requirements or to be on an accessible route.

203.9 Employee work areas. Spaces and elements within employee work areas shall only be required to comply with Subsections 206.2.8, 207.1, and 215.3 and shall be designed and constructed so that individuals with disabilities can approach, enter, and exit the employee work area. Employee work areas, or portions of employee work areas, other than raised courtroom stations, that are less than 300 square feet and elevated 7 inches or more above the finish floor or ground where the elevation is essential to the function of the space shall not be required to comply with these requirements or to be on an accessible route.

Advisory 203.9 Employee Work Areas. Although areas used exclusively by employees for work are not required to be fully accessible, consider designing such areas to include nonrequired turning spaces, and provide accessible elements whenever possible. Under the ADA, employees with disabilities are entitled to reasonable accommodations in the workplace; accommodations can include alterations to

spaces within the facility. Designing employee work areas to be more accessible at the outset will avoid more costly retrofits when current employees become temporarily or permanently disabled, or when new employees with disabilities are hired. Contact the Equal Employment Opportunity Commission (EEOC) at www.eeoc.gov for information about title I of the ADA prohibiting discrimination against people with disabilities in the workplace.

203.10 Raised refereeing, judging, and scoring areas. Raised structures used solely for refereeing, judging, or scoring a sport shall not be required to comply with these requirements or to be on an accessible route.

203.11 Water slides. Water slides shall not be required to comply with these requirements or to be on an accessible route.

203.12 Animal containment areas. Animal containment areas that are not for public use shall not be required to comply with these requirements or to be on an accessible route.

Advisory 203.12 Animal containment areas. Public circulation routes where animals may travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

203.13 Raised boxing or wrestling rings. Raised boxing or wrestling rings shall not be required to comply with these requirements or to be on an accessible route.

203.14 Raised diving boards and diving platforms. Raised diving boards and diving platforms shall not be required to comply with these requirements or to be on an accessible route.

203.15 Structural impracticability.

203.15.1 Full compliance with the requirements of this Subsection is not required where an entity can demonstrate that it is structurally impracticable to meet the requirements. Full compliance will be considered structurally impracticable only in those rare circumstances when the unique characteristics of terrain prevent the incorporation of accessibility features.

203.15.2 If full compliance with this Subsection would be structurally impracticable, compliance with this Subsection is required to the extent that it is not structurally impracticable. In that case, any portion of the facility that can be made accessible shall be made accessible to the extent that it is not structurally impracticable.

203.15.3 If providing accessibility in conformance with this Section to individuals with certain disabilities (e.g., those who use wheelchairs) would be structurally impracticable, accessibility shall nonetheless be ensured to persons with other types of disabilities (e.g., those who use crutches or who have sight, hearing, or mental impairments) in accordance with this Subsection.

SECTION 204 PROTRUDING OBJECTS

204.1 General. Protruding objects on circulation paths shall comply with Section 307.

Exceptions:

1. Within areas of sport activity, protruding objects on circulation paths shall not be required to comply with Section 307.
2. Within play areas, protruding objects on circulation paths shall not be required to comply with Section 307 provided that ground level accessible routes provide vertical clearance in compliance with Subsection 1008.2.

SECTION 205 OPERABLE PARTS

205.1 General. Operable parts on accessible elements, accessible routes, and in accessible rooms and spaces shall comply with Section 309.

Exceptions:

1. Operable parts that are intended for use only by service or maintenance personnel shall not be required to comply with Section 309.
2. Electrical or communication receptacles serving a dedicated use shall not be required to comply with Section 309.
3. Where two or more outlets are provided in a kitchen above a length of counter top that is uninterrupted by a sink or appliance, one outlet shall not be required to comply with Section 309.
4. Floor electrical receptacles shall not be required to comply with Section 309.
5. HVAC diffusers shall not be required to comply with Section 309.
6. Except for light switches, where redundant controls are provided for a single element, one control in each space shall not be required to comply with Section 309.
7. Cleats and other boat securement devices shall not be required to comply with Subsection 309.3.
8. Exercise machines and exercise equipment shall not be required to comply with Section 309.

Advisory 205.1 General. Controls covered by this Subsection include, but are not limited to, light switches, circuit breakers, duplexes and other convenience receptacles, environmental and appliance controls, plumbing fixture controls, and security and intercom systems.

SECTION 206 ACCESSIBLE ROUTES

206.1 General. Accessible routes shall be provided in accordance with this Section and shall comply with Chapter 4.

206.2 Where required. Accessible routes shall be provided where required by this Subsection.

206.2.1 Site arrival points. At least one accessible route shall be provided within the site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve.

Exceptions:

1. Where exceptions for alterations to qualified historic buildings or facilities are permitted by Subsection 202.5, no more than one accessible route from a site arrival point to an accessible entrance shall be required.
2. An accessible route shall not be required between site arrival points and the building or facility entrance if the only means of access between them is a vehicular way not providing pedestrian access.

Advisory 206.2.1 Site arrival points. Each site arrival point must be connected by an accessible route to the accessible building entrance or entrances served. Where two or more similar site arrival points, such as bus stops, serve the same accessible entrance or entrances, both bus stops must be on accessible routes. In addition, the accessible routes must serve all of the accessible entrances on the site.

Advisory 206.2.1 Site arrival points Exception 2. Access from site arrival points may include vehicular ways. Where a vehicular way, or a portion of a vehicular way, is provided for pedestrian travel, such as within a shopping center or shopping mall parking lot, this exception does not apply.

206.2.2 Within a site. At least one accessible route shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site.

Exception: An accessible route shall not be required between accessible buildings, accessible facilities, accessible elements, and accessible spaces if the only means of access between them is a vehicular way not providing pedestrian access.

Advisory 206.2.2 Within a site. An accessible route is required to connect to the boundary of each area of sport activity. Examples of areas of sport activity include: soccer fields, basketball courts, baseball fields, running tracks, skating rinks, and the area surrounding a piece of gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. Where multiple sports fields or courts are provided, an accessible route is required to each field or area of sport activity.

206.2.3 Multistory buildings and facilities. At least one accessible route shall connect each story and mezzanine in multistory buildings and facilities.

Notwithstanding the requirements and exceptions of this Section, Subsection 201.1.1 shall apply.

Exceptions:

1. Reserved.

2. Reserved.
3. Reserved.
4. Reserved.
5. Reserved.
6. Reserved.
7. Reserved.

Advisory 206.2.3 Multistory buildings and facilities.

Spaces and elements located on a level not required to be served by an accessible route must fully comply with this Code. While a mezzanine may be a change in level, it is not a story. If an accessible route is required to connect stories within a building or facility, the accessible route must serve all mezzanines.

Advisory 206.2.3 Multistory buildings and facilities exceptions. Exceptions 1 through 7 are preempted by Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1. Florida requirements may be waived down to the ADA Standards requirements.

Note: The following Advisories on the Exceptions to Subsection 206.2.3 are provided for consideration when waiving Florida Vertical Accessibility requirements down to ADA Standards for Accessible Design.

Advisory 206.2.3 Multistory buildings and facilities Exception 1. Note that Exception 1 as presented in the 2004 ADAAG must also comply with the elevator exemption criteria of 28 CFR 36.401(d). The elevator exemption is authorized by 28 CFR 36.401(d) and applies only to private entities governed by Title III but not to public entities governed by Title II and 28 CFR, Part 35. Note also that 28 CFR 36.401(d)(2) and (3) provide specific criteria expanding on the criteria of Exception 1 that must be considered in a waiver of Florida vertical accessibility.

Advisory 206.2.3 Multistory buildings and facilities Exception 2. Note that Exception 2 for a required accessible route applies to public entities, is not modified by 28 CFR, Part 35 and parallels the exception for vertical accessibility in Section 553.509(1)(c), F.S., and Subsection 201.1.1(3).

Advisory 206.2.3 Multistory buildings and facilities Exception 4. Where common use areas are provided for the use of residents, it is presumed that all such common use areas “serve” accessible dwelling units unless use is restricted to residents occupying certain dwelling units. For example, if all residents are permitted to use all laundry rooms, then all laundry rooms “serve” accessible dwelling units. However, if the laundry room on the first floor is restricted to use by residents on the first floor, and the second floor laundry room is for use by occupants of the second floor, then first floor accessible units are “served” only by laundry rooms on the first floor. In this example, an accessible route is not required to the second floor provided that all accessible units and all common use areas serving them are on the first floor.

206.2.3.1 Stairs and escalators in existing buildings.

In alterations and additions, where an escalator or stair is provided where none existed previously and major structural modifications are necessary for the installation, an accessible route shall be provided between the levels served by the escalator or stair unless exempted by Subsection 206.2.3, Exceptions 1 through 7.

206.2.4 Spaces and elements. At least one accessible route shall connect accessible building or facility entrances with all accessible spaces and elements within the building or facility which are otherwise connected by a circulation path unless exempted by Subsection 206.2.3, Exceptions 1 through 7.

Notwithstanding the requirements and exceptions of this Section, Subsection 201.1.1 shall apply.

Exceptions:

1. Reserved.
2. Reserved.
3. Reserved.

Advisory 206.2.4 Spaces and elements. Accessible routes must connect all spaces and elements required to be accessible including, but not limited to, raised areas and speaker platforms.

Advisory 206.2.4 Spaces and elements exceptions. Exceptions 1 through 3 are preempted by Florida vertical accessibility requirements of s.553.509, F.S., as incorporated in Subsection 201.1.1. Florida requirements may be waived down to the ADA Standards requirements.

Note: The following ADAAG Advisory on Exceptions 1 to Subsection 206.2.4 is retained for consideration when waiving Florida Vertical Accessibility requirements down to ADA Standards for Accessible Design.

Advisory 206.2.4 Spaces and Elements Exception 1. The exception does not apply to areas that are likely to be used by members of the public who are not employees of the court such as jury areas, attorney areas, or witness stands.

206.2.5 Restaurants and cafeterias. In restaurants and cafeterias, an accessible route shall be provided to all dining areas, including raised or sunken dining areas, and outdoor dining areas.

Notwithstanding the requirements and exceptions of this Section, Subsection 201.1.1 shall apply.

Exceptions:

1. Reserved.
2. Reserved.
3. Reserved.

Advisory 206.2.5 Restaurants and cafeterias Exceptions. Exceptions 1 through 3 are preempted by Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1. Florida requirements may be waived down to the ADA Standards requirements.

Advisory 206.2.5 Restaurants and Cafeterias Exception

2. Examples of “same services” include, but are not limited to, bar service, rooms having smoking and nonsmoking sections, lotto and other table games, carry-out, and buffet service. Examples of “same decor” include, but are not limited to, seating at or near windows and railings with views, areas designed with a certain theme, party and banquet rooms, and rooms where entertainment is provided.

206.2.6 Performance areas. Where a circulation path directly connects a performance area to an assembly seating area, an accessible route shall directly connect the assembly seating area with the performance area. An accessible route shall be provided from performance areas to ancillary areas or facilities used by performers unless exempted by Subsection 206.2.3, Exceptions 1 through 7.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

206.2.7 Press boxes. Press boxes in assembly areas shall be on an accessible route.

Notwithstanding the requirements and exceptions of this Section, Subsection 201.1.1 shall apply.

Exceptions:

1. Reserved.
2. Reserved.

Advisory 206.2.7 Press boxes. Exceptions 1 through 3 are preempted by Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1. Florida requirements may be waived down to the ADA Standards requirements.

Advisory 206.2.7 Press boxes, Exception 2. Where a facility contains multiple assembly areas, the aggregate area of the press boxes in each assembly area is to be calculated separately. For example, if a university has a soccer stadium with three press boxes elevated 12 feet or more above grade and each press box is 150 square feet, then the aggregate area of the soccer stadium press boxes is less than 500 square feet and Exception 2 applies to the soccer stadium. If that same university also has a football stadium with two press boxes elevated 12 feet or more above grade and one press box is 250 square feet, and the second is 275 square feet, then the aggregate area of the football stadium press boxes is more than 500 square feet and Exception 2 does not apply to the football stadium.

206.2.8 Employee work areas. Common use circulation paths within employee work areas shall comply with Section 402.

Exceptions:

1. Common use circulation paths within employee work areas that are less than 1,000 square feet and defined by permanently installed partitions, counters, casework, or furnishings shall not be required to comply with Section 402.
2. Common use circulation paths located within employee work areas that are an integral compo-

nent of work area equipment shall not be required to comply with Section 402.

3. Common use circulation paths located within exterior employee work areas that are fully exposed to the weather shall not be required to comply with Section 402.

Advisory 206.2.8 Employee work areas Exception 1.

Modular furniture that is not permanently installed is not directly subject to these requirements. The Department of Justice ADA regulations provide additional guidance regarding the relationship between these requirements and elements that are not part of the built environment. Additionally, the Equal Employment Opportunity Commission (EEOC) implements title I of the ADA which requires non-discrimination in the workplace. EEOC can provide guidance regarding employers’ obligations to provide reasonable accommodations for employees with disabilities.

Advisory 206.2.8 Employee work areas Exception 2.

Large pieces of equipment, such as electric turbines or water pumping apparatus, may have stairs and elevated walkways used for overseeing or monitoring purposes which are physically part of the turbine or pump. However, passenger elevators used for vertical transportation between stories are not considered “work area equipment” as defined in Subsection 106.5.

206.2.9 Amusement rides. Amusement rides required to comply with Section 234 shall provide accessible routes in accordance with this Subsection. Accessible routes serving amusement rides shall comply with Chapter 4 except as modified by Subsection 1002.2.

206.2.9.1 Load and unload areas. Load and unload areas shall be on an accessible route. Where load and unload areas have more than one loading or unloading position, at least one loading and unloading position shall be on an accessible route.

206.2.9.2 Wheelchair spaces, ride seats designed for transfer, and transfer devices. When amusement rides are in the load and unload position, wheelchair spaces complying with Subsection 1002.4, amusement ride seats designed for transfer complying with Subsection 1002.5, and transfer devices complying with Subsection 1002.6 shall be on an accessible route.

206.2.10 Recreational boating facilities. Boat slips required to comply with Subsection 235.2 and boarding piers at boat launch ramps required to comply with Subsection 235.3 shall be on an accessible route. Accessible routes serving recreational boating facilities shall comply with Chapter 4, except as modified by Subsection 1003.2.

206.2.11 Bowling lanes. where bowling lanes are provided, at least 5 percent, but no fewer than one of each type of bowling lane, shall be on an accessible route.

206.2.12 Court sports. In court sports, at least one accessible route shall directly connect both sides of the court.

206.2.13 Exercise machines and equipment. Exercise machines and equipment required to comply with Section 236 shall be on an accessible route.

206.2.14 Fishing piers and platforms. Fishing piers and platforms shall be on an accessible route. Accessible routes serving fishing piers and platforms shall comply with Chapter 4 except as modified by Subsection 1005.1.

206.2.15 Golf facilities. At least one accessible route shall connect accessible elements and spaces within the boundary of the golf course. In addition, accessible routes serving golf car rental areas; bag drop areas; course weather shelters complying with Subsection 238.2.3; course toilet rooms; and practice putting greens, practice teeing grounds, and teeing stations at driving ranges complying with Subsection 238.3 shall comply with Chapter 4 except as modified by Subsection 1006.2.

Exception: Golf car passages complying with Subsection 1006.3 shall be permitted to be used for all or part of accessible routes required by this Subsection.

206.2.16 Miniature golf facilities. Holes required to comply with Subsection 239.2, including the start of play, shall be on an accessible route. Accessible routes serving miniature golf facilities shall comply with Chapter 4 except as modified by Subsection 1007.2.

206.2.17 Play areas. Play areas shall provide accessible routes in accordance with this Subsection. Accessible routes serving play areas shall comply with Chapter 4 except as modified by Subsection 1008.2.

206.2.17.1 Ground level and elevated play components. At least one accessible route shall be provided within the play area. The accessible route shall connect ground level play components required to comply with Subsection 240.2.1 and elevated play components required to comply with Subsection 240.2.2, including entry and exit points of the play components.

206.2.17.2 Soft contained play structures. Where three or fewer entry points are provided for soft contained play structures, at least one entry point shall be on an accessible route. Where four or more entry points are provided for soft contained play structures, at least two entry points shall be on an accessible route.

206.3 Location. Accessible routes shall coincide with or be located in the same area as general circulation paths. Where circulation paths are interior, required accessible routes shall also be interior.

For transportation facilities subject to Department of Transportation regulation 49 CFR 37.21, elements such as ramps, elevators, or other circulation devices, fare vending or other ticketing areas, and fare collection areas shall be placed to minimize the distance which wheelchair users and other persons who cannot negotiate steps may have to travel compared to the general public.

Advisory 206.3 Location. The accessible route must be in the same area as the general circulation path. This means that circulation paths, such as vehicular ways designed for pedestrian traffic, walks, and unpaved paths that are designed to be routinely used by pedestrians must be accessible or have an accessible route nearby. Additionally, accessible vertical interior circulation must be in the same area as stairs and escalators, not isolated in the back of the facility.

206.4 Entrances. Entrances shall be provided in accordance with this Subsection. Entrance doors, doorways, and gates shall comply with Section 404 and shall be on an accessible route complying with Section 402.

Exceptions:

1. Where an alteration includes alterations to an entrance, and the building or facility has another entrance complying with Section 404 that is on an accessible route, the altered entrance shall not be required to comply with this Subsection unless required by Subsection 202.4.
2. Where exceptions for alterations to qualified historic buildings or facilities are permitted by Subsection 202.5, no more than one public entrance shall be required to comply with this Subsection. Where no public entrance can comply with this Subsection under criteria established in the exception to Subsection 202.5 Exception, then either an unlocked entrance not used by the public shall comply with this Subsection; or a locked entrance complying with this Subsection with a notification system or remote monitoring shall be provided.

206.4.1 Public entrances. In addition to entrances required by Subsections 206.4.2 through 206.4.9, at least 60 percent of all public entrances shall comply with Section 404.

Barriers at common or emergency entrances and exits of business establishments conducting business with the general public that are existing, under construction, or under contract for construction which would prevent a person from using such entrances or exits shall be removed.

206.4.2 Parking structure entrances. Where direct access is provided for pedestrians from a parking structure to a building or facility entrance, each direct access to the building or facility entrance shall comply with Section 404.

206.4.3 Entrances from tunnels or elevated walkways. Where direct access is provided for pedestrians from a pedestrian tunnel or elevated walkway to a building or facility, at least one direct entrance to the building or facility from each tunnel or walkway shall comply with Section 404.

206.4.4 Transportation facilities. In addition to the requirements of Subsections 206.4.2, 206.4.3, and 206.4.5 through 206.4.9, transportation facilities shall provide entrances in accordance with this Subsection.

206.4.4.1 Location. In transportation facilities, where different entrances serve different transportation fixed routes or groups of fixed routes, at least one public entrance serving each fixed route or group of fixed routes shall comply with Section 404.

Exception: Entrances to key stations and existing intercity rail stations retrofitted in accordance with 49 CFR 37.49 or 49 CFR 37.51 shall not be required to comply with this Subsection.

206.4.4.2 Direct connections. Direct connections to other facilities shall provide an accessible route complying with Section 404 from the point of connection to boarding platforms and all transportation system ele-

ments required to be accessible. Any elements provided to facilitate future direct connections shall be on an accessible route connecting boarding platforms and all transportation system elements required to be accessible.

Exception: In key stations and existing intercity rail stations, existing direct connections shall not be required to comply with Section 404.

206.4.4.3 Key stations and intercity rail stations. Key stations and existing intercity rail stations required by Subpart C of 49 CFR part 37 to be altered, shall have at least one entrance complying with Section 404.

206.4.5 Tenant spaces. At least one accessible entrance to each tenancy in a facility shall comply with Section 404.

Exception: Self-service storage facilities not required to comply with Subsection 225.3 shall not be required to be on an accessible route.

206.4.6 Residential dwelling unit primary entrance. In residential dwelling units, at least one primary entrance shall comply with Section 404. The primary entrance to a residential dwelling unit shall not be to a bedroom.

206.4.7 Restricted entrances. Where restricted entrances are provided to a building or facility, at least one restricted entrance to the building or facility shall comply with Section 404.

206.4.8 Service entrances. If a service entrance is the only entrance to a building or to a tenancy in a facility, that entrance shall comply with Section 404.

206.4.9 Entrances for inmates or detainees. Where entrances used only by inmates or detainees and security personnel are provided at judicial facilities, detention facilities, or correctional facilities, at least one such entrance shall comply with Section 404.

206.5 Doors, doorways, and gates. Doors, doorways, and gates providing user passage shall be provided in accordance with this Subsection.

Barriers at common or emergency entrances and exits of business establishments conducting business with the general public that are existing, under construction, or under contract for construction which would prevent a person from using such entrances or exits shall be removed.

206.5.1 Entrances. Each entrance to a building or facility required to comply with Subsection 206.4 shall have at least one door, doorway, or gate complying with Section 404.

206.5.2 Rooms and spaces. Within a building or facility, at least one door, doorway, or gate serving each room or space complying with these requirements shall comply with Section 404.

206.5.3 Transient lodging facilities. In transient lodging facilities, entrances, doors, and doorways providing user passage into and within guestrooms that are not required to provide mobility features complying with Subsection 806.2 shall comply with Subsection 404.2.3.

Exception: Shower and sauna doors in guestrooms that are not required to provide mobility features complying with Subsection 806.2 shall not be required to comply with Subsection 404.2.3.

206.5.4 Residential dwelling units. In residential dwelling units required to provide mobility features complying with Subsections 809.2 through 809.4, all doors and doorways providing user passage shall comply with Section 404.

206.6 Elevators. Elevators provided for passengers shall comply with Section 407. Where multiple elevators are provided, each elevator shall comply with Section 407.

Exceptions:

1. In a building or facility permitted to use the exceptions to Subsection 206.2.3 or permitted by Subsection 206.7 to use a platform lift, elevators complying with Section 408 shall be permitted.
2. Elevators complying with Section 408 or 409 shall be permitted in multistory residential dwelling units.

206.6.1 Existing elevators. Where elements of existing elevators are altered, the same element shall also be altered in all elevators that are programmed to respond to the same hall call control as the altered elevator and shall comply with the requirements of Section 407 for the altered element.

206.7 Platform lifts. Platform lifts shall comply with Section 410. Platform lifts shall be permitted as a component of an accessible route in new construction in accordance with this Subsection. Platform lifts shall be permitted as a component of an accessible route in an existing building or facility.

206.7.1 Performance areas and speakers' platforms. Platform lifts shall be permitted to provide accessible routes to performance areas and speakers' platforms.

206.7.2 Wheelchair spaces. Platform lifts shall be permitted to provide an accessible route to comply with the wheelchair space dispersion and line-of-sight requirements of Sections 221 and 802.

206.7.3 Incidental spaces. Platform lifts shall be permitted to provide an accessible route to incidental spaces which are not public use spaces and which are occupied by five persons maximum.

206.7.4 Judicial spaces. Platform lifts shall be permitted to provide an accessible route to: jury boxes and witness stands; raised courtroom stations including judges' benches, clerks' stations, bailiffs' stations, deputy clerks' stations, and court reporters' stations; and to depressed areas such as the well of a court.

206.7.5 Existing site constraints. Platform lifts shall be permitted where existing exterior site constraints make use of a ramp or elevator infeasible.

Advisory 206.7.5 Existing site constraints. This exception applies where topography or other similar existing site constraints necessitate the use of a platform lift as the only feasible alternative. While the site constraint must reflect exterior conditions, the lift can be installed in the interior of a building. For example, a new building constructed between and connected to two existing buildings may have insufficient space to coordinate floor levels and also to provide ramped entry from the public way. In this example, an exterior or interior platform lift could be used to provide an accessible entrance or to coordinate one or more interior floor levels.

206.7.6 Guestrooms and residential dwelling units. Platform lifts shall be permitted to connect levels within transient lodging guestrooms required to provide mobility features complying with Subsection 806.2 or residential dwelling units required to provide mobility features complying with Subsections 809.2 through 809.4.

206.7.7 Amusement rides. Platform lifts shall be permitted to provide accessible routes to load and unload areas serving amusement rides.

206.7.8 Play areas. Platform lifts shall be permitted to provide accessible routes to play components or soft contained play structures.

206.7.9 Team or player seating. Platform lifts shall be permitted to provide accessible routes to team or player seating areas serving areas of sport activity.

Advisory 206.7.9 Team or player seating. While the use of platform lifts is allowed, ramps are recommended to provide access to player seating areas serving an area of sport activity.

206.7.10 Recreational boating facilities and fishing piers and platforms. Platform lifts shall be permitted to be used instead of gangways that are part of accessible routes serving recreational boating facilities and fishing piers and platforms.

206.8 Security barriers. Security barriers, including but not limited to, security bollards and security check points, shall not obstruct a required accessible route or accessible means of egress.

Exception: Where security barriers incorporate elements that cannot comply with these requirements such as certain metal detectors, fluoroscopes, or other similar devices, the accessible route shall be permitted to be located adjacent to security screening devices. The accessible route shall permit persons with disabilities passing around security barriers to maintain visual contact with their personal items to the same extent provided others passing through the security barrier.

SECTION 207 ACCESSIBLE MEANS OF EGRESS

207.1 General. Accessible means of egress shall comply with this Section. Accessible spaces shall be provided with not less than one accessible means of egress. Where more than one means of egress is required by the *EPCOT Building Code* from any accessible space, each accessible portion of the space shall be served by not less than two accessible means of egress.

Exceptions:

1. Where means of egress are permitted by local building or life safety codes to share a common path of egress travel, accessible means of egress shall be permitted to share a common path of egress travel.
2. Areas of refuge shall not be required in detention and correctional facilities.

3. Accessible means of egress are not required in alterations to existing buildings.
4. One accessible means of egress is required from an accessible mezzanine level in accordance with Subsections 207.3 or 207.4.
5. In assembly spaces with sloped floors, one accessible means of egress is required from a space where the common path of travel of the accessible route for access to the wheelchair spaces is not more than 30 feet from a location where there is a choice of two accessible means of egress available.

207.1.1 Barriers at common or emergency entrances and exits of business establishments conducting business with the general public that are existing, under construction, or under contract for construction which would prevent a person from using such entrances or exits shall be removed.

207.2 Continuity and components. Each required accessible means of egress shall be continuous to a public way and shall consist of one or more of the following components:

1. Accessible routes complying with Chapter 4.
2. Stairways within exit enclosures complying with Subsection 207.3 and the *EPCOT Building Code*.
3. Elevators complying with Subsection 207.4.
4. Platform lifts complying with Subsection 207.5.
5. Horizontal exits complying with the *EPCOT Building Code*.
6. Smoke barriers complying with the *EPCOT Building Code*.

Exceptions:

1. Where the exit discharge is not accessible, an exterior area for assisted rescue must be provided in accordance with Subsection 207.8.
2. Where the exit stairway is open to the exterior, the accessible means of egress shall include either an area of refuge in accordance with Subsection 207.6 or an exterior area for assisted rescue in accordance with Subsection 207.8.

207.2.1 Buildings with four or more stories. In buildings where a required accessible floor is four or more stories above or below a level of exit discharge, at least one required accessible means of egress shall be an elevator complying with Subsection 207.4.

Exceptions:

1. In buildings equipped throughout with an automatic sprinkler system installed in accordance with the *EPCOT Building Code*, the elevator shall not be required on floors provided with a horizontal exit and located at or above the level of exit discharge.
2. In buildings equipped throughout with an automatic sprinkler system installed in accordance with the *EPCOT Building Code*, the elevator shall not be required on floors provided with a

ramp conforming to the provisions of Section 405.

207.3 Enclosed exit stairways. An enclosed exit stairway, to be considered part of an accessible means of egress, shall have a clear width of 48 inches minimum between handrails and shall either incorporate an area of refuge within an enlarged floor-level landing or shall be accessed from either an area of refuge complying with Subsection 207.6 or a horizontal exit.

Exceptions:

1. Open exit stairways as permitted by the *EPCOT Building Code* are permitted to be considered part of an accessible means of egress.
2. The clear width of 48 inches between handrails and the area of refuge is not required at exit stairways in buildings or facilities equipped throughout with an automatic sprinkler system installed in accordance with the *EPCOT Building Code*.
3. The clear width of 48 inches between handrails is not required for enclosed exit stairways accessed from a horizontal exit.
4. Areas of refuge are not required at exit stairways serving open parking garages.

207.4 Elevators. An elevator to be considered part of an accessible means of egress shall comply with the emergency operation and signaling device requirements of Section 2.27 of ASME A17.1. Standby power shall be provided in accordance with the *EPCOT Electrical Code*. The elevator shall be accessed from either an area of refuge complying with Subsection 207.6 or a horizontal exit.

Exceptions:

1. Elevators are not required to be accessed from an area of refuge or horizontal exit in open parking garages.
2. Elevators are not required to be accessed from an area of refuge or horizontal exit in buildings and facilities equipped throughout with an automatic sprinkler system installed in accordance with the *EPCOT Building Code*.

207.5 Platform lifts. Platform (wheelchair) lifts shall not serve as part of an accessible means of egress, except where allowed as part of a required accessible route in accordance with Subsection 206.7 and installed in accordance with Section 410. Standby power shall be provided for platform lifts permitted to serve as part of a means of egress.

207.6 Areas of refuge. Every required area of refuge shall be accessible from the space it serves by an accessible means of egress. The maximum travel distance from any accessible space to an area of refuge shall not exceed the travel distance permitted for the occupancy in accordance with the *EPCOT Building Code*. Every required area of refuge shall have direct access to an enclosed stairway complying with Subsection 207.3 and the *EPCOT Building Code* or an elevator complying with Subsection 207.4. Where an elevator lobby is used as an area of refuge, the shaft and lobby shall comply with the *EPCOT Building Code* for smoke proof enclosures except where the elevators are in an area of refuge formed by a horizontal exit or smoke barrier.

207.6.1 Size. Each area of refuge shall be sized to accommodate one wheelchair space of 30 inches by 48 inches for each 200 occupants or portion thereof, based on the occupant load of the area of refuge and areas served by the area of refuge. Such wheelchair spaces shall not reduce the required means of egress width. Access to any of the required wheelchair spaces in an area of refuge shall not be obstructed by more than one adjoining wheelchair space.

207.6.2 Separation. Each area of refuge shall be separated from the remainder of the story by a smoke barrier complying with the *EPCOT Building Code*. Each area of refuge shall be designed to minimize the intrusion of smoke.

Exceptions:

1. Areas of refuge located within a stairway enclosure.
2. Areas of refuge where the area of refuge and areas served by the area of refuge are equipped throughout with an automatic sprinkler system installed in accordance with the *EPCOT Building Code*.

207.6.3 Two-way communication. Areas of refuge shall be provided with a two-way communication system between the area of refuge and a central control point. If the central control point is not constantly attended, the area of refuge shall also have controlled access to a public telephone system. Location of the central control point shall be approved by the fire department. The two-way communication system shall include both audible and visible signals.

207.6.4 Instructions. In areas of refuge that have a two-way emergency communications system, instructions on the use of the area under emergency conditions shall be posted adjoining the communications system. The instructions shall include all of the following:

1. Directions to find other means of egress.
2. Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
3. Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.
4. Directions for use of the emergency communications system.

207.6.5 Identification. Each door providing access to an area of refuge from an adjacent floor area shall be identified by a sign complying with ICC A117.1, stating: AREA OF REFUGE, and including the International Symbol of Accessibility. Where exit sign illumination is required by the *EPCOT Building Code*, the area of refuge sign shall be illuminated. Additionally, tactile signage complying with ICC A117.1 shall be located at each door to an area of refuge.

207.7 Signage. At exits and elevators serving a required accessible space but not providing an approved accessible means of egress, signage shall be installed indicating the location of accessible means of egress.

207.8 Exterior area for assisted rescue. The exterior area for assisted rescue must be open to the outside air and meet the requirements of Subsection 207.6.1. Separation walls shall comply with the requirements of the *EPCOT Building Code* for exterior walls. Where walls or openings are between the area for assisted rescue and the interior of the building, the building exterior walls within 10 feet horizontally of a nonrated wall or unprotected opening shall be constructed as required for a minimum 1-hour fire-resistance rating with $\frac{3}{4}$ -hour opening protectives. This construction shall extend vertically from the ground to a point 10 feet above the floor level of the area for assisted rescue or to the roof line, whichever is lower.

207.8.1 Openness. The exterior area for assisted rescue shall be at least 50 percent open, and the open area above the guards shall be so distributed as to minimize the accumulation of smoke or toxic gases.

207.8.2 Exterior exit stairway. Exterior exit stairways that are part of the means of egress for the exterior area for assisted rescue shall provide a clear width of 48 inches between handrails.

207.8.3 Identification. Exterior areas for assisted rescue shall have identification as required for area of refuge that complies with Subsection 207.6.5.

SECTION 208 PARKING SPACES

208.1 General. Where parking spaces are provided, parking spaces shall be provided in accordance with this Section. See Subsection 502.5 requirements for van parking in structures.

Exception: Parking spaces used exclusively for buses, trucks, other delivery vehicles, law enforcement vehicles, or vehicular impound shall not be required to comply with this Section provided that lots accessed by the public are provided with a passenger loading zone complying with Section 503.

208.1.1 The removal of architectural barriers from a parking facility in accordance with 28 C.F.R. Section 36.304 or with Section 553.508, F. S., must comply with this Section unless compliance would cause the barrier removal not to be readily achievable. If compliance would cause the barrier removal not to be readily achievable, a facility may provide parking spaces at alternative locations for persons who have disabilities and provide appropriate signage directing such persons to the alternative parking if readily achievable. The facility may not reduce the required number or dimensions of those spaces or unreasonably increase the length of the accessible route from a parking space to the facility. The removal of an architectural barrier must not create a significant risk to the health or safety of a person who has a disability or to that of others.

208.1.2 A facility that is making alterations under Section 202 as required by Section 303(a) of the Americans with Disabilities Act of 1990 must comply with this Section to the maximum extent feasible. If compliance with parking location requirements is not feasible, the facility may provide parking spaces at alternative locations for persons who have disabilities and provide appropriate signage

directing such persons to alternative parking. The facility may not reduce the required number or dimensions of those spaces, or unnecessarily increase the length of the accessible route from a parking space to the facility. The alteration must not create a significant risk to the health or safety of a person who has a disability or to others.

208.2 Minimum number. Parking spaces complying with Section 502 shall be provided in accordance with Table 208.2 except as required by Subsections 208.2.1, 208.2.2, and 208.2.3. Where more than one parking facility is provided on a site, the number of accessible spaces provided on the site shall be calculated according to the number of spaces required for each parking facility.

The number of parking spaces for persons who have disabilities must be increased on the basis of demonstrated and documented need.

Advisory 208.2 Minimum number. The term “parking facility” is used in Subsection 208.2 instead of the term “parking lot” so that it is clear that both parking lots and parking structures are required to comply with this Section. The number of parking spaces required to be accessible is to be calculated separately for each parking facility; the required number is not to be based on the total number of parking spaces provided in all of the parking facilities provided on the site.

**TABLE 208.2
PARKING SPACES**

TOTAL NUMBER OF PARKING SPACES PROVIDED IN PARKING FACILITY	MINIMUM NUMBER OF REQUIRED ACCESSIBLE PARKING SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2 percent of total
1,001 and over	20, plus 1 for each 100, or fraction thereof, over 1,000

208.2.1 Hospital outpatient facilities. Ten percent of patient and visitor parking spaces provided to serve hospital outpatient facilities shall comply with Section 502.

Advisory 208.2.1 Hospital outpatient facilities. The term “outpatient facility” is not defined in this Code but is intended to cover facilities or units that are located in hospitals and that provide regular and continuing medical treatment without an overnight stay. Doctors’ offices, independent clinics, or other facilities not located in hospitals are not considered hospital outpatient facilities for purposes of this Code.

208.2.2 Rehabilitation facilities and outpatient physical therapy facilities. Twenty percent of patient and visitor parking spaces provided to serve rehabilitation facilities specializing in treating conditions that affect mobility and outpatient physical therapy facilities shall comply with Section 502.

Advisory 208.2.2 Rehabilitation facilities and outpatient physical therapy facilities. Conditions that affect mobility include conditions requiring the use or assistance of a brace, cane, crutch, prosthetic device, wheelchair, or powered mobility aid; arthritic, neurological, or orthopedic conditions that severely limit one's ability to walk; respiratory diseases and other conditions which may require the use of portable oxygen; and cardiac conditions that impose significant functional limitations.

208.2.3 Residential facilities. Parking spaces provided to serve residential facilities shall comply with this Subsection.

208.2.3.1 Parking for residents. Where at least one parking space is provided for each residential dwelling unit, at least one parking space complying with Section 502 shall be provided for each residential dwelling unit required to provide mobility features complying with Subsections 809.2 through 809.4.

208.2.3.2 Additional parking spaces for residents. Where the total number of parking spaces provided for each residential dwelling unit exceeds one parking space per residential dwelling unit, 2 percent, but no fewer than one space, of all the parking spaces not covered by Subsection 208.2.3.1 shall comply with Section 502.

208.2.3.3 Parking for guests, employees, and other nonresidents. Where parking spaces are provided for persons other than residents, parking shall be provided in accordance with Table 208.2.

208.2.4 Van parking spaces. Where van parking is provided pursuant to Subsection 502.2, for every six or fraction of six parking spaces required by Subsection 208.2 to comply with Section 502, at least one shall be a van parking space complying with Section 502.

208.2.5 Parking spaces provided by state agencies and political subdivisions.

208.2.5.1 There must be one accessible parking space in the immediate vicinity of a publicly owned or leased building that houses a governmental entity or a political subdivision, including, but not limited to, state office buildings and courthouses, if parking for the public is not provided on the premises of the building.

208.2.5.2 There must be one accessible parking space for each 150 metered on-street parking spaces provided by state agencies and political subdivisions.

Exception: State agencies and political subdivisions having jurisdiction over street parking or publicly owned or operated parking facilities are not required to provide a greater right-of-way width than would

otherwise be planned under regulations, guidelines, or practices normally applied to new development.

208.3 Location. Parking facilities shall comply with this Subsection.

208.3.1 General. Designated accessible spaces shall be designed and marked for the exclusive use of those individuals who have a severe physical disability and have permanent or temporary mobility problems that substantially impair their ability to ambulate and who have been issued either a disabled parking permit under Section 316.1958 or Section 320.0848 or a license plate under Section 320.084, 320.0842, 320.0843, or 320.0845. Parking spaces complying with Section 502 that serve a particular building or facility shall be located on the shortest accessible route from parking to an entrance complying with Subsection 206.4. All spaces must be located on an accessible route that is at least 44 inches wide and so that users are not compelled to walk or wheel behind parked vehicles except behind his or her own vehicle. Where parking serves more than one accessible entrance, parking spaces complying with Section 502 shall be dispersed and located on the shortest accessible route to the accessible entrances. If there are multiple entrances for multiple retail stores the parking spaces must be dispersed to provide parking at the nearest accessible entrance. In parking facilities that do not serve a particular building or facility, parking spaces complying with Section 502 shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility.

Exceptions:

1. All van parking spaces shall be permitted to be grouped on one level within a multistory parking facility.
2. Parking spaces shall be permitted to be located in different parking facilities if substantially equivalent or greater accessibility is provided in terms of distance from an accessible entrance or entrances, parking fee, and user convenience.
3. If a theme park or entertainment complex provides parking in several lots or areas from which access to the theme park or entertainment complex is provided, a single lot or area may be designated for parking by persons who have disabilities, if the lot or area is located on the shortest accessible route to an accessible entrance to the theme park or entertainment complex or to transportation to such an accessible entrance.
4. A theme park or entertainment complex in which are provided continuous attendant services for directing individuals to marked accessible parking spaces or designated lots for parking by persons who have disabilities, may, in lieu of the required parking space design, provide parking spaces that comply with Sections 208 and 502 of the *ADA Standards for Accessible Design*.

Advisory 208.3.1 General Exception 2. Factors that could affect “user convenience” include, but are not limited to, protection from the weather, security, lighting, and comparative maintenance of the alternative parking site.

Florida law adds dispersion requirements for accessible parking where multiple parking areas are provided and for multiple entrances for multiple retail stores. Accessible routes from accessible parking to accessible entrances are required to be 44 inches wide minimum. Exceptions are established for the Florida specific requirements only (indicated by gray shading) for theme parks and entertainment complexes by added exceptions 3 and 4.

208.3.2 Residential facilities. In residential facilities containing residential dwelling units required to provide mobility features complying with Subsections 809.2 through 809.4, parking spaces provided in accordance with Subsection 208.2.3.1 shall be located on the shortest accessible route to the residential dwelling unit entrance they serve. Spaces provided in accordance with Subsection 208.2.3.2 shall be dispersed throughout all types of parking provided for the residential dwelling units.

Exception: Parking spaces provided in accordance with Subsection 208.2.3.2 shall not be required to be dispersed throughout all types of parking if substantially equivalent or greater accessibility is provided in terms of distance from an accessible entrance, parking fee, and user convenience.

Advisory 208.3.2 Residential facilities exception. Factors that could affect “user convenience” include, but are not limited to, protection from the weather, security, lighting, and comparative maintenance of the alternative parking site.

SECTION 209 PASSENGER LOADING ZONES AND BUS STOPS

209.1 General. Passenger loading zones shall be provided in accordance with this Section.

209.2 Type. Where provided, passenger loading zones shall comply with this Subsection.

209.2.1 Passenger loading zones. Passenger loading zones, except those required to comply with Subsections 209.2.2 and 209.2.3, shall provide at least one passenger loading zone complying with Section 503 in every continuous 100 linear feet of loading zone space, or fraction thereof.

209.2.2 Bus loading zones. In bus loading zones restricted to use by designated or specified public transportation vehicles, each bus bay, bus stop, or other area designated for lift or ramp deployment shall comply with Subsection 810.2.

Advisory 209.2.2 Bus loading zones. The terms “designated public transportation” and “specified public transportation” are defined by the Department of Transportation at 49 CFR 37.3 in regulations implementing the Americans with Disabilities Act. These terms refer to public transportation services provided by public or private entities, respectively.

For example, designated public transportation vehicles include buses and vans operated by public transit agencies, while specified public transportation vehicles include tour and charter buses, taxis and limousines, and hotel shuttles operated by private entities.

209.2.3 On-street bus stops. On-street bus stops shall comply with Subsection 810.2 to the maximum extent practicable.

209.3 Medical care and long-term care facilities. At least one passenger loading zone complying with Section 503 shall be provided at an accessible entrance to licensed medical care and licensed long-term care facilities where the period of stay exceeds twenty-four hours.

209.4 Valet parking. Parking facilities that provide valet parking services shall provide at least one passenger loading zone complying with Section 503.

209.5 Mechanical access parking garages. Mechanical access parking garages shall provide at least one passenger loading zone complying with Section 503 at vehicle drop-off and vehicle pick-up areas.

SECTION 210 STAIRWAYS

210.1 General. Interior and exterior stairs that are part of a means of egress shall comply with Section 504.

Exceptions:

1. In detention and correctional facilities, stairs that are not located in public use areas shall not be required to comply with Section 504.
2. In alterations, stairs between levels that are connected by an accessible route shall not be required to comply with Section 504, except that handrails complying with Section 505 shall be provided when the stairs are altered.
3. In assembly areas, aisle stairs shall not be required to comply with Section 504.
4. Stairs that connect play components shall not be required to comply with Section 504.

Advisory 210.1 General. Although these requirements do not mandate handrails on stairs that are not part of a means of egress, State or local building codes may require handrails or guards.

SECTION 211 DRINKING FOUNTAINS

211.1 General. Where drinking fountains are provided on an exterior site, on a floor, or within a secured area they shall be provided in accordance with this Section.

Exception: In detention or correctional facilities, drinking fountains only serving holding or housing cells not required to comply with Section 232 shall not be required to comply with this Section.

SCOPING REQUIREMENTS

211.2 Minimum number. No fewer than two drinking fountains shall be provided. One drinking fountain shall comply with Subsections 602.1 through 602.6 and one drinking fountain shall comply with Subsection 602.7.

Exception: Where a single drinking fountain complies with Subsections 602.1 through 602.6 and Subsection 602.7, it shall be permitted to be substituted for two separate drinking fountains.

211.3 More than minimum number. Where more than the minimum number of drinking fountains specified in Subsection 211.2 are provided, 50 percent of the total number of drinking fountains provided shall comply with Subsections 602.1 through 602.6, and 50 percent of the total number of drinking fountains provided shall comply with Subsection 602.7.

Exception: Where 50 percent of the drinking fountains yields a fraction, 50 percent shall be permitted to be rounded up or down provided that the total number of drinking fountains complying with this Section equals 100 percent of drinking fountains.

SECTION 212 KITCHENS, KITCHENETTES, AND SINKS

212.1 General. Where provided, kitchens, kitchenettes, and sinks shall comply with this Section.

212.2 Kitchens and kitchenettes. Kitchens and kitchenettes shall comply with Section 804.

212.3 Sinks. Where sinks are provided, at least 5 percent, but no fewer than one, of each type provided in each accessible room or space shall comply with Section 606.

Exception: Mop or service sinks shall not be required to comply with this Subsection.

SECTION 213 TOILET FACILITIES AND BATHING FACILITIES

213.1 General. Where toilet facilities and bathing facilities are provided, they shall comply with this Section. Where toilet facilities and bathing facilities are provided in facilities permitted by Exceptions 1 and 2 of Subsection 206.2.3 not to connect stories by an accessible route, toilet facilities and bathing facilities shall be provided on a story connected by an accessible route to an accessible entrance.

213.2 Toilet rooms and bathing rooms. Where toilet rooms are provided, each toilet room shall comply with Section 603. Where bathing rooms are provided, each bathing room shall comply with Section 603.

Exceptions:

1. In alterations where it is technically infeasible to comply with Section 603, altering existing toilet or bathing rooms shall not be required where a single unisex toilet room or bathing room complying with Subsection 213.2.1 is provided and located in the same area and on the same floor as existing in accessible toilet or bathing rooms.
2. Where exceptions for alterations to qualified historic buildings or facilities are permitted by Subsection 202.5, no fewer than one toilet room for each sex com-

plying with Section 603 or one unisex toilet room complying with Subsection 213.2.1 shall be provided.

3. Where multiple single user portable toilet or bathing units are clustered at a single location, no more than 5 percent of the toilet units and bathing units at each cluster shall be required to comply with Section 603. Portable toilet units and bathing units complying with 603 shall be identified by the International Symbol of Accessibility complying with Subsection 703.7.2.1.
4. Where multiple single user toilet rooms are clustered at a single location, no more than 50 percent of the single user toilet rooms for each use at each cluster shall be required to comply with Section 603.

Advisory 213.2 Toilet rooms and bathing rooms. These requirements allow the use of unisex (or single-user) toilet rooms in alterations when technical infeasibility can be demonstrated. Unisex toilet rooms benefit people who use opposite sex personal care assistants. For this reason, it is advantageous to install unisex toilet rooms in addition to accessible single-sex toilet rooms in new facilities.

Advisory 213.2 Toilet rooms and bathing rooms Exceptions 3 and 4. A “cluster” is a group of toilet rooms proximate to one another. Generally, toilet rooms in a cluster are within sight of, or adjacent to, one another.

213.2.1 Unisex (single-use or family) toilet and unisex bathing rooms. Unisex toilet rooms shall contain not more than one lavatory, and two water closets without urinals or one water closet and one urinal. Unisex bathing rooms shall contain one shower or one shower and one bathtub, one lavatory, and one water closet. Doors to unisex toilet rooms and unisex bathing rooms shall have privacy latches.

213.3 Plumbing fixtures and accessories. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with Subsection 213.2 shall comply with this Subsection.

213.3.1 Toilet compartments. Where toilet compartments are provided, at least one toilet compartment shall comply with Subsection 604.8.1. In addition to the compartment required to comply with Subsection 604.8.1, at least one compartment shall comply with Subsection 604.8.2 where six or more toilet compartments are provided, or where the combination of urinals and water closets totals six or more fixtures.

Advisory 213.3.1 Toilet compartments. A toilet compartment is a partitioned space that is located within a toilet room, and that normally contains no more than one water closet. A toilet compartment may also contain a lavatory. A lavatory is a sink provided for hand washing. Full-height partitions and door assemblies can comprise toilet compartments where the minimum required spaces are provided within the compartment.

213.3.2 Water closets. Where water closets are provided, at least one shall comply with Section 604.

213.3.3 Urinals. Where more than one urinal is provided, at least one shall comply with Section 605.

213.3.4 Lavatories. Where lavatories are provided, at least one shall comply with Section 606 and shall not be located in a toilet compartment.

213.3.5 Mirrors. Where mirrors are provided, at least one shall comply with Subsection 603.3.

213.3.6 Bathing facilities. Where bathtubs or showers are provided, at least one bathtub complying with Section 607 or at least one shower complying with Section 608 shall be provided.

213.3.7 Coat hooks and shelves. Where coat hooks or shelves are provided in toilet rooms without toilet compartments, at least one of each type shall comply with Subsection 603.4. Where coat hooks or shelves are provided in toilet compartments, at least one of each type complying with Subsection 604.8.3 shall be provided in toilet compartments required to comply with Subsection 213.3.1. Where coat hooks or shelves are provided in bathing facilities, at least one of each type complying with Subsection 603.4 shall serve fixtures required to comply with Subsection 213.3.6.

SECTION 214

WASHING MACHINES AND CLOTHES DRYERS

214.1 General. Where provided, washing machines and clothes dryers shall comply with this Section.

214.2 Washing Machines. Where three or fewer washing machines are provided, at least one shall comply with Section 611. Where more than three washing machines are provided, at least two shall comply with Section 611.

214.3 Clothes dryers. Where three or fewer clothes dryers are provided, at least one shall comply with Section 611. Where more than three clothes dryers are provided, at least two shall comply with Section 611.

SECTION 215

FIRE ALARM SYSTEMS

215.1 General. Where fire alarm systems provide audible alarm coverage, alarms shall comply with this Section.

Exception: In existing facilities, visible alarms shall not be required except where an existing fire alarm system is upgraded or replaced, or a new fire alarm system is installed.

Advisory 215.1 General. Unlike audible alarms, visible alarms must be located within the space they serve so that the signal is visible. Facility alarm systems (other than fire alarm systems) such as those used for tornado warnings and other emergencies are not required to comply with the technical criteria for alarms in Section 702. Every effort should be made to ensure that such alarms can be differentiated in their signal from fire alarms systems and that people who need to be notified of emergencies are adequately safeguarded. Consult local fire departments and prepare evacuation plans taking into consideration the needs of every building occupant, including people with disabilities.

215.2 Public and common use areas. Alarms in public use areas and common use areas shall comply with Section 702.

215.3 Employee work areas. Where employee work areas have audible alarm coverage, the wiring system shall be designed so that visible alarms complying with Section 702 can be integrated into the alarm system.

215.4 Transient lodging. Guestrooms required to comply with Subsection 224.4 shall provide alarms complying with Section 702.

215.5 Residential facilities. Where provided in residential dwelling units required to comply with Subsection 809.5, alarms shall comply with Section 702.

SECTION 216

SIGNS

216.1 General. Signs shall be provided in accordance with Section 216 and shall comply with Section 703.

Exceptions:

1. Building directories, menus, seat and row designations in assembly areas, occupant names, building addresses, and company names and logos shall not be required to comply with this Section.
2. In parking facilities, signs shall not be required to comply with Subsections 216.2, 216.3, and 216.6 through 216.12.
3. Temporary, seven days or less, signs shall not be required to comply with this Section.
4. In detention and correctional facilities, signs not located in public use areas shall not be required to comply with this Section.

216.2 Designations. Interior and exterior signs identifying permanent rooms and spaces shall comply with Subsections 703.1, 703.2, and 703.5. Where pictograms are provided as designations of permanent interior rooms and spaces, the pictograms shall comply with Subsection 703.6 and shall have text descriptors complying with Subsections 703.2 and 703.5.

Exception: Exterior signs that are not located at the door to the space they serve shall not be required to comply with Subsection 703.2.

Advisory 216.2 Designations. This Subsection applies to signs that provide designations, labels, or names for interior rooms or spaces where the sign is not likely to change over time. Examples include interior signs labeling restrooms, room and floor numbers or letters, and room names. Tactile text descriptors are required for pictograms that are provided to label or identify a permanent room or space. Pictograms that provide information about a room or space, such as “no smoking,” occupant logos, and the International Symbol of Accessibility, are not required to have text descriptors.

216.3 Directional and informational signs. Signs that provide direction to or information about interior spaces and facilities of the site shall comply with Subsection 703.5.

Advisory 216.3 Directional and informational signs.

Information about interior spaces and facilities includes rules of conduct, occupant load, and similar signs. Signs providing direction to rooms or spaces include those that identify egress routes.

216.4 Means of egress. Signs for means of egress shall comply with this Subsection.

216.4.1 Exit doors. Doors at exit passageways, exit discharge, and exit stairways shall be identified by tactile signs complying with Subsections 703.1, 703.2, and 703.5.

Advisory 216.4.1 Exit doors. An exit passageway is a horizontal exit component that is separated from the interior spaces of the building by fire-resistance-rated construction and that leads to the exit discharge or public way. The exit discharge is that portion of an egress system between the termination of an exit and a public way.

216.4.2 Areas of refuge. In areas of refuge that have a two-way emergency communications system, instructions on the use of the area under emergency conditions shall be posted adjoining the communications system. The instructions shall include all of the following:

1. Directions to find other means of egress.
2. Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
3. Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.
4. Directions for use of the emergency communications system.

216.4.3 Directional signs. Signs required by Section 813 of the *EPCOT Building Code* to provide directions to accessible means of egress shall comply with Subsection 703.5.

216.5 Parking. Parking spaces complying with Section 502 shall be identified by signs complying with Subsection 502.6.

Exceptions:

1. Reserved.
2. In residential facilities, where parking spaces are assigned to specific residential dwelling units, identification of accessible parking spaces shall not be required.

216.6 Entrances. Where not all entrances comply with Section 404, entrances complying with Section 404 shall be identified by the International Symbol of Accessibility complying with Subsection 703.7.2.1. Directional signs complying with Subsection 703.5 that indicate the location of the nearest entrance complying with Section 404 shall be provided at entrances that do not comply with Section 404.

Advisory 216.6 Entrances. Where a directional sign is required, it should be located to minimize backtracking. In some cases, this could mean locating a sign at the beginning of a route, not just at the inaccessible entrances to a building.

216.7 Elevators. Where existing elevators do not comply with Section 407, elevators complying with Section 407 shall be clearly identified with the International Symbol of Accessibility complying with Subsection 703.7.2.1.

216.8 Toilet rooms and bathing rooms. Where existing toilet rooms or bathing rooms do not comply with Section 603, directional signs indicating the location of the nearest toilet room or bathing room complying with Section 603 within the facility shall be provided. Signs shall comply with Subsection 703.5 and shall include the International Symbol of Accessibility complying with Subsection 703.7.2.1. Where existing toilet rooms or bathing rooms do not comply with Section 603, the toilet rooms or bathing rooms complying with Section 603 shall be identified by the International Symbol of Accessibility complying with Subsection 703.7.2.1. Where clustered single user toilet rooms or bathing facilities are permitted to use exceptions to Subsection 213.2, toilet rooms or bathing facilities complying with Section 603 shall be identified by the International Symbol of Accessibility complying with Subsection 703.7.2.1 unless all toilet rooms and bathing facilities comply with Section 603.

216.9 TTYs. Identification and directional signs for public TTYs shall be provided in accordance with this Subsection.

216.9.1 Identification signs. Public TTYs shall be identified by the International Symbol of TTY complying with Subsection 703.7.2.2.

216.9.2 Directional signs. Directional signs indicating the location of the nearest public TTY shall be provided at all banks of public pay telephones not containing a public TTY. In addition, where signs provide direction to public pay telephones, they shall also provide direction to public TTYs. Directional signs shall comply with Subsection 703.5 and shall include the International Symbol of TTY complying with Subsection 703.7.2.2.

216.10 Assistive listening systems. Each assembly area required by Section 219 to provide assistive listening systems shall provide signs informing patrons of the availability of the assistive listening system. Assistive listening signs shall comply with Subsection 703.5 and shall include the International Symbol of Access for Hearing Loss complying with Subsection 703.7.2.4.

Exception: Where ticket offices or windows are provided, signs shall not be required at each assembly area provided that signs are displayed at each ticket office or window informing patrons of the availability of assistive listening systems.

216.11 Check-out aisles. Where more than one check-out aisle is provided, check-out aisles complying with Subsection 904.3 shall be identified by the International Symbol of Accessibility complying with Subsection 703.7.2.1. Where check-out aisles are identified by numbers, letters, or functions, signs identifying check-out aisles complying with Subsection 904.3 shall be located in the same location as the check-out aisle identification.

Exception: Where all check-out aisles serving a single function comply with Subsection 904.3, signs complying with Subsection 703.7.2.1 shall not be required.

216.12 Amusement rides. Signs identifying the type of access provided on amusement rides shall be provided at entries to queues and waiting lines. In addition, where accessible unload areas also serve as accessible load areas, signs indicating the location of the accessible load and unload areas shall be provided at entries to queues and waiting lines.

Advisory 216.12 Amusement rides. Amusement rides designed primarily for children, amusement rides that are controlled or operated by the rider, and amusement rides without seats, are not required to provide wheelchair spaces, transfer seats, or transfer systems, and need not meet the sign requirements in this Subsection. The load and unload areas of these rides must, however, be on an accessible route and must provide turning space.

SECTION 217 TELEPHONES

217.1 General. Where coin-operated public pay telephones, coinless public pay telephones, public closed-circuit telephones, public courtesy phones, or other types of public telephones are provided, public telephones shall be provided in accordance with this Section for each type of public telephone provided. For purposes of this Section, a bank of telephones shall be considered to be two or more adjacent telephones.

Advisory 217.1 General. These requirements apply to all types of public telephones including courtesy phones at airports and rail stations that provide a free direct connection to hotels, transportation services, and tourist attractions.

217.2 Wheelchair accessible telephones. Where public telephones are provided, wheelchair accessible telephones complying with Subsection 704.2 shall be provided in accordance with Table 217.2.

Exception: Drive-up only public telephones shall not be required to comply with this Subsection.

**TABLE 217.2
WHEELCHAIR ACCESSIBLE TELEPHONES**

NUMBER OF TELEPHONES PROVIDED ON A FLOOR, LEVEL, OR EXTERIOR SITE	MINIMUM NUMBER OF REQUIRED WHEELCHAIR ACCESSIBLE TELEPHONES
1 or more single units	1 per floor, level, and exterior site
1 bank	1 per floor, level, and exterior site
2 or more banks	1 per bank

217.3 Volume Controls. All public telephones shall have volume controls complying with Subsection 704.3.

217.4 TTYs. TTYs complying with Subsection 704.4 shall be provided in accordance with this Subsection.

Advisory 217.4 TTYs. Separate requirements are provided based on the number of public pay telephones provided at a bank of telephones, within a floor, a building, or on a site. In some instances one TTY can be used to satisfy more than one of these requirements. For example, a TTY required for a bank can satisfy the requirements for a building. However, the requirement for at least one TTY on an exterior site cannot be met by installing a TTY in a bank inside a building.

Consideration should be given to phone systems that can accommodate both digital and analog transmissions for compatibility with digital and analog TTYs.

217.4.1 Bank requirement. Where four or more public pay telephones are provided at a bank of telephones, at least one public TTY complying with Subsection 704.4 shall be provided at that bank.

Exception: TTYs shall not be required at banks of telephones located within 200 feet of, and on the same floor as, a bank containing a public TTY.

217.4.2 Floor requirement. TTYs in public buildings shall be provided in accordance with Subsection 217.4.2.1. TTYs in private buildings shall be provided in accordance with Subsection 217.4.2.2.

217.4.2.1 Public buildings. Where at least one public pay telephone is provided on a floor of a public building, at least one public TTY shall be provided on that floor.

217.4.2.2 Private buildings. Where four or more public pay telephones are provided on a floor of a private building, at least one public TTY shall be provided on that floor.

217.4.3 Building requirement. TTYs in public buildings shall be provided in accordance with Subsection 217.4.3.1. TTYs in private buildings shall be provided in accordance with Subsection 217.4.3.2.

217.4.3.1 Public buildings. Where at least one public pay telephone is provided in a public building, at least one public TTY shall be provided in the building. Where at least one public pay telephone is provided in a public use area of a public building, at least one public TTY shall be provided in the public building in a public use area.

217.4.3.2 Private buildings. Where four or more public pay telephones are provided in a private building, at least one public TTY shall be provided in the building.

217.4.4 Exterior site requirement. Where four or more public pay telephones are provided on an exterior site, at least one public TTY shall be provided on the site.

217.4.5 Rest stops, emergency roadside stops, and service plazas. Where at least one public pay telephone is provided at a public rest stop, emergency roadside stop, or service plaza, at least one public TTY shall be provided.

217.4.6 Hospitals. Where at least one public pay telephone is provided serving a hospital emergency room, hospital recovery room, or hospital waiting room, at least one public TTY shall be provided at each location.

217.4.7 Transportation facilities. In transportation facilities, in addition to the requirements of Subsections 217.4.1 through 217.4.4, where at least one public pay telephone serves a particular entrance to a bus or rail facility, at least one public TTY shall be provided to serve that entrance. In airports, in addition to the requirements of Subsections 217.4.1 through 217.4.4, where four or more public pay telephones are located in a terminal outside the security areas, a concourse within the security areas, or a baggage claim area in a terminal, at least one public TTY shall be provided in each location.

SCOPING REQUIREMENTS

217.4.8 Detention and correctional facilities. In detention and correctional facilities, where at least one pay telephone is provided in a secured area used only by detainees or inmates and security personnel, at least one TTY shall be provided in at least one secured area.

217.5 Shelves for portable TTYs. Where a bank of telephones in the interior of a building consists of three or more public pay telephones, at least one public pay telephone at the bank shall be provided with a shelf and an electrical outlet in accordance with Subsection 704.5.

Exceptions:

1. Secured areas of detention and correctional facilities where shelves and outlets are prohibited for purposes of security or safety shall not be required to comply with this Subsection.
2. The shelf and electrical outlet shall not be required at a bank of telephones with a TTY.

SECTION 218 TRANSPORTATION FACILITIES

218.1 General. Transportation facilities shall comply with this Section.

218.2 New and altered fixed guideway stations. New and altered stations in rapid rail, light rail, commuter rail, intercity rail, high speed rail, and other fixed guideway systems shall comply with Subsections 810.5 through 810.10.

218.3 Key stations and existing intercity rail stations. Key stations and existing intercity rail stations shall comply with Subsections 810.5 through 810.10.

218.4 Bus shelters. Where provided, bus shelters shall comply with Subsection 810.3.

218.5 Other transportation facilities. In other transportation facilities, public address systems shall comply with Subsection 810.7 and clocks shall comply with Subsection 810.8.

SECTION 219 ASSISTIVE LISTENING SYSTEMS

219.1 General. Assistive listening systems shall be provided in accordance with this Section and shall comply with Section 706.

219.2 Required systems. In each assembly area where audible communication is integral to the use of the space, an assistive listening system shall be provided.

Exception: Other than in courtrooms, assistive listening systems shall not be required where audio amplification is not provided.

219.3 Receivers. Receivers complying with Subsection 706.2 shall be provided for assistive listening systems in each assembly area in accordance with Table 219.3. Twenty-five percent minimum of receivers provided, but no fewer than two, shall be hearing-aid compatible in accordance with Subsection 706.3.

Exceptions:

1. Where a building contains more than one assembly area and the assembly areas required to provide assis-

tive listening systems are under one management, the total number of required receivers shall be permitted to be calculated according to the total number of seats in the assembly areas in the building provided that all receivers are usable with all systems.

2. Where all seats in an assembly area are served by an induction loop assistive listening system, the minimum number of receivers required by Table 219.3 to be hearing-aid compatible shall not be required to be provided.

**TABLE 219.3
RECEIVERS FOR ASSISTIVE LISTENING SYSTEMS**

CAPACITY OF SEATING IN ASSEMBLY AREA	MINIMUM NUMBER OF REQUIRED RECEIVERS	MINIMUM NUMBER OF REQUIRED RECEIVERS REQUIRED TO BE HEARING-AID COMPATIBLE
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats ¹	2
201 to 500	2, plus 1 per 25 seats over 50 seats ¹	1 per 4 receivers ¹
501 to 1,000	20, plus 1 per 33 seats over 500 seats ¹	1 per 4 receivers ¹
1,001 to 2,000	35, plus 1 per 50 seats over 1,000 seats ¹	1 per 4 receivers ¹
2,001 and over	55 plus 1 per 100 seats over 2,000 seats ¹	1 per 4 receivers ¹

1. Or fraction thereof.

SECTION 220 AUTOMATIC TELLER MACHINES AND FARE MACHINES

220.1 General. Where automatic teller machines or self-service fare vending, collection, or adjustment machines are provided, at least one of each type provided at each location shall comply with Section 707. Where bins are provided for envelopes, waste paper, or other purposes, at least one of each type shall comply with Section 811.

Advisory 220.1 General. If a bank provides both interior and exterior ATMs, each such installation is considered a separate location. Accessible ATMs, including those with speech and those that are within reach of people who use wheelchairs, must provide all the functions provided to customers at that location at all times. For example, it is unacceptable for the accessible ATM only to provide cash withdrawals while inaccessible ATMs also sell theater tickets.

SECTION 221 ASSEMBLY AREAS

221.1 General. Assembly areas shall provide wheelchair spaces, companion seats, and designated aisle seats complying with this Section and Section 802. In addition, lawn seating shall comply with Subsection 221.5.

221.1.1 Florida vertical accessibility. Nothing in this Code relieves the owner of any building, structure, or facility governed by this Code from the duty to provide

vertical accessibility to all levels above and below the occupiable grade level, regardless of whether the ADA *Standards for Accessible Design* require an elevator to be installed in such building, structure or facility.

Exception: Theaters, concert halls, and stadiums, or other large assembly areas that have stadium-style seating or tiered seating if the requirements of this Section and Section 802 are met.

221.2 Wheelchair spaces. Wheelchair spaces complying with this Subsection shall be provided in assembly areas with fixed seating.

221.2.1 Number and location. Wheelchair spaces shall be provided complying with this Subsection.

221.2.1.1 General seating. Wheelchair spaces complying with Subsection 802.1 shall be provided in accordance with Table 221.2.1.1.

**TABLE 221.2.1.1
SEATING CAPACITY**

CAPACITY OF SEATING IN ASSEMBLY AREAS	NUMBER OF REQUIRED WHEELCHAIR LOCATIONS
4 to 25	1
26 to 50	2
51 to 150	4
151 to 300	5
301 to 500	6
501 to 5,000	6, plus 1 for each 150, or fraction thereof between 501 through 5,000
5,001 and over	36, plus 1 for each 200, or fraction thereof over 5,000

221.2.1.2 Luxury boxes, club boxes, and suites in arenas, stadiums, and grandstands. In each luxury box, club box, and suite within arenas, stadiums, and grandstands, wheelchair spaces complying with Subsection 802.1 shall be provided in accordance with Table 221.2.1.1.

Advisory 221.2.1.2 Luxury boxes, club boxes, and suites in arenas, stadiums, and grandstands. The number of wheelchair spaces required in luxury boxes, club boxes, and suites within an arena, stadium, or grandstand is to be calculated box by box and suite by suite.

221.2.1.3 Other boxes. In boxes other than those required to comply with Subsection 221.2.1.2, the total number of wheelchair spaces required shall be determined in accordance with Table 221.2.1.1. Wheelchair spaces shall be located in not less than 20 percent of all boxes provided. Wheelchair spaces shall comply with Subsection 802.1.

Advisory 221.2.1.3 Other boxes. The provision for seating in “other boxes” includes box seating provided in facilities such as performing arts auditoria where tiered boxes are designed for spatial and acoustical purposes. The number of wheelchair spaces required in boxes covered by this Subsection is calculated based on the total

number of seats provided in these other boxes. The resulting number of wheelchair spaces must be located in no fewer than 20 percent of the boxes covered by this Section. For example, a concert hall has 20 boxes, each of which contains 10 seats, totaling 200 seats. In this example, five wheelchair spaces would be required, and they must be placed in at least four of the boxes. Additionally, because the wheelchair spaces must also meet the dispersion requirements of Subsection 221.2.3, the boxes containing these wheelchair spaces cannot all be located in one area unless an exception to the dispersion requirements applies.

221.2.1.4 Team or player seating. At least one wheelchair space complying with Subsection 802.1 shall be provided in team or player seating areas serving areas of sport activity.

Exception: Wheelchair spaces shall not be required in team or player seating areas serving bowling lanes not required to comply with Subsection 206.2.11.

221.2.2 Integration. Wheelchair spaces shall be an integral part of the seating plan.

Advisory 221.2.2 Integration. The requirement that wheelchair spaces be an “integral part of the seating plan” means that wheelchair spaces must be placed within the footprint of the seating area. Wheelchair spaces cannot be segregated from seating areas. For example, it would be unacceptable to place only the wheelchair spaces, or only the wheelchair spaces and their associated companion seats, outside the seating areas defined by risers in an assembly area.

221.2.3 Lines of sight and dispersion. Wheelchair spaces shall provide lines of sight complying with Subsection 802.2 and shall comply with this Subsection. In providing lines of sight, wheelchair spaces shall be dispersed. Wheelchair spaces shall provide spectators with choices of seating locations and viewing angles that are substantially equivalent to, or better than, the choices of seating locations and viewing angles available to all other spectators. When the number of wheelchair spaces required by Subsection 221.2.1 has been met, further dispersion shall not be required.

Exception: wheelchair spaces in team or player seating areas serving areas of sport activity shall not be required to comply with this Subsection.

Advisory 221.2.3 Lines of sight and dispersion. Consistent with the overall intent of the ADA, individuals who use wheelchairs must be provided equal access so that their experience is substantially equivalent to that of other members of the audience. Thus, while individuals who use wheelchairs need not be provided with the best seats in the house, neither may they be relegated to the worst.

221.2.3.1 Horizontal dispersion. Wheelchair spaces shall be dispersed horizontally.

Exceptions:

1. Horizontal dispersion shall not be required in assembly areas with 300 or fewer seats if the

companion seats required by Subsection 221.3 and wheelchair spaces are located within the second or third quartile of the total row length. Intermediate aisles shall be included in determining the total row length. If the row length in the second and third quartile of a row is insufficient to accommodate the required number of companion seats and wheelchair spaces, the additional companion seats and wheelchair spaces shall be permitted to be located in the first and fourth quartile of the row.

2. In row seating, two wheelchair spaces shall be permitted to be located side-by-side.

Advisory 221.2.3.1 Horizontal dispersion. Horizontal dispersion of wheelchair spaces is the placement of spaces in an assembly facility seating area from side-to-side or, in the case of an arena or stadium, around the field of play or performance area.

221.2.3.2 Vertical dispersion. Wheelchair spaces shall be dispersed vertically at varying distances from the screen, performance area, or playing field. In addition, wheelchair spaces shall be located in each balcony or mezzanine that is located on an accessible route.

Exceptions:

1. Vertical dispersion shall not be required in assembly areas with 300 or fewer seats if the wheelchair spaces provide viewing angles that are equivalent to, or better than, the average viewing angle provided in the facility.
2. In bleachers, wheelchair spaces shall not be required to be provided in rows other than rows at points of entry to bleacher seating.

Advisory 221.2.3.2 Vertical dispersion. When wheelchair spaces are dispersed vertically in an assembly facility they are placed at different locations within the seating area from front-to-back so that the distance from the screen, stage, playing field, area of sports activity, or other focal point is varied among wheelchair spaces.

Advisory 221.2.3.2 Vertical dispersion Exception 2. Points of entry to bleacher seating may include, but are not limited to, cross aisles, concourses, vomitories, and entrance ramps and stairs. Vertical, center, or side aisles adjoining bleacher seating that are stepped or tiered are not considered entry points.

221.3 Companion seats. At least one companion seat complying with Subsection 802.3 shall be provided for each wheelchair space required by Subsection 221.2.1.

221.4 Designated aisle seats. At least 5 percent of the total number of aisle seats provided shall comply with Subsection 802.4 and shall be the aisle seats located closest to accessible routes.

Exception: Team or player seating areas serving areas of sport activity shall not be required to comply with this Subsection.

Advisory 221.4 Designated aisle seats. When selecting which aisle seats will meet the requirements of Subsection 802.4, those aisle seats which are closest to, not necessarily on, accessible routes must be selected first. For example, an assembly area has two aisles (A and B) serving seating areas with an accessible route connecting to the top and bottom of Aisle A only. The aisle seats chosen to meet Subsection 802.4 must be those at the top and bottom of Aisle A, working toward the middle. Only when all seats on Aisle A would not meet the five percent minimum would seats on Aisle B be designated.

221.5 Lawn seating. Lawn seating areas and exterior overflow seating areas, where fixed seats are not provided, shall connect to an accessible route.

221.6 Stadiums, arenas, and grandstands. Wheelchair spaces and companion seats shall be dispersed to all levels that include seating served by an accessible route.

221.7 Seating encircling a field of play or performance. In assembly areas that are required to horizontally disperse wheelchair spaces and companion seats by Subsection 221.2.3.1 and that have seating encircling, in whole or in part, a field of play or performance, wheelchair spaces and companion seats shall be dispersed around that field of play or performance area.

221.8 Temporary platforms or other movable structures. Wheelchair spaces and companion seats shall not be located on (or obstructed by) temporary platforms or other movable structures, except that when an entire seating section is placed on temporary platforms or other movable structures in an area where fixed seating is not provided, in order to increase seating for an event, wheelchair spaces and companion seats may be placed in that section. When wheelchair spaces and companion seats are not required to accommodate persons eligible for those spaces and seats, individual, removable seats may be placed in those spaces and seats.

221.9 Stadium style movie theaters. Wheelchair spaces and companion seats shall be located on a riser or cross-aisle in the stadium section that satisfies at least one of the following criteria: (i) It is located within the rear 60 percent of the seats provided in an auditorium; or (ii) It is located within the area of an auditorium in which the vertical viewing angles (as measured to the top of the screen) are from the 40th to the 100th percentile of vertical viewing angles for all seats as ranked from the seats in the first row (1st percentile) to seats in the back row (100th percentile).

SECTION 222 DRESSING, FITTING, AND LOCKER ROOMS

222.1 General. Where dressing rooms, fitting rooms, or locker rooms are provided, at least 5 percent, but no fewer than one, of each type of use in each cluster provided shall comply with Section 803.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

Exception: In alterations, where it is technically infeasible to provide rooms in accordance with this Subsection, one

room for each sex on each level shall comply with Section 803. where only unisex rooms are provided, unisex rooms shall be permitted.

Advisory 222.1 General. A “cluster” is a group of rooms proximate to one another. Generally, rooms in a cluster are within sight of, or adjacent to, one another. Different styles of design provide users varying levels of privacy and convenience. Some designs include private changing facilities that are close to core areas of the facility, while other designs use space more economically and provide only group dressing facilities. Regardless of the type of facility, dressing, fitting, and locker rooms should provide people with disabilities rooms that are equally private and convenient to those provided others. For example, in a physician’s office, if people without disabilities must traverse the full length of the office suite in clothing other than their street clothes, it is acceptable for people with disabilities to be asked to do the same.

Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1 require vertical access to all levels of rooms. Florida requirements may be waived down to the ADA Standards requirements.

222.2 Coat hooks and shelves. Where coat hooks or shelves are provided in dressing, fitting or locker rooms without individual compartments, at least one of each type shall comply with Subsection 803.5. Where coat hooks or shelves are provided in individual compartments at least one of each type complying with Subsection 803.5 shall be provided in individual compartments in dressing, fitting, or locker rooms required to comply with Subsection 222.1.

SECTION 223 MEDICAL CARE AND LONG-TERM CARE FACILITIES

223.1 General. In licensed medical care facilities and licensed long-term care facilities where the period of stay exceeds twenty-four hours, patient or resident sleeping rooms shall be provided in accordance with this Section.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

Exception: Toilet rooms that are part of critical or intensive care patient sleeping rooms shall not be required to comply with Section 603.

Advisory 223.1 General. Because medical facilities frequently reconfigure spaces to reflect changes in medical specialties, this Subsection does not include a provision for dispersion of accessible patient or resident sleeping rooms. The lack of a design requirement does not mean that covered entities are not required to provide services to people with disabilities where accessible rooms are not dispersed in specialty areas. Locate accessible rooms near core areas that are less likely to change over time. While dispersion is not required, the flexibility it provides can be a critical factor in ensuring cost effective compliance with applicable civil rights laws,

including titles II and III of the ADA and Section 504 of the Rehabilitation Act of 1973, as amended. Additionally, all types of features and amenities should be dispersed among accessible sleeping rooms to ensure equal access to and a variety of choices for all patients and residents.

Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1 require vertical access to all levels of facilities. Florida requirements may be waived down to the ADA Standards requirements.

223.1.1 Alterations. Where sleeping rooms are altered or added, the requirements of this Section shall apply only to the sleeping rooms being altered or added until the number of sleeping rooms complies with the minimum number required for new construction.

Advisory 223.1.1 Alterations. In alterations and additions, the minimum required number is based on the total number of sleeping rooms altered or added instead of on the total number of sleeping rooms provided in a facility. As a facility is altered over time, every effort should be made to disperse accessible sleeping rooms among patient care areas such as pediatrics, cardiac care, maternity, and other units. In this way, people with disabilities can have access to the full-range of services provided by a medical care facility.

223.2 Hospitals, rehabilitation facilities, psychiatric facilities and detoxification facilities. Hospitals, rehabilitation facilities, psychiatric facilities and detoxification facilities shall comply with this Subsection.

223.2.1 Facilities not specializing in treating conditions that affect mobility. In facilities not specializing in treating conditions that affect mobility, at least 10 percent, but no fewer than one, of the patient sleeping rooms shall provide mobility features complying with Section 805. Accessible patient bedrooms shall be dispersed in a manner that is proportionate by type of medical specialty.

223.2.2 Facilities specializing in treating conditions that affect mobility. In facilities specializing in treating conditions that affect mobility, 100 percent of the patient sleeping rooms shall provide mobility features complying with Section 805.

Advisory 223.2.2 Facilities specializing in treating conditions that affect mobility. Conditions that affect mobility include conditions requiring the use or assistance of a brace, cane, crutch, prosthetic device, wheelchair, or powered mobility aid; arthritic, neurological, or orthopedic conditions that severely limit one’s ability to walk; respiratory diseases and other conditions which may require the use of portable oxygen; and cardiac conditions that impose significant functional limitations. Facilities that may provide treatment for, but that do not specialize in treatment of such conditions, such as general rehabilitation hospitals, are not subject to this requirement but are subject to Subsection 223.2.1.

SCOPING REQUIREMENTS

223.3 Long-term care facilities. In licensed long-term care facilities, at least 50 percent, but no fewer than one, of each type of resident sleeping room shall provide mobility features complying with Section 805.

SECTION 224 TRANSIENT LODGING GUESTROOMS

224.1 General. Transient lodging facilities shall provide guestrooms in accordance with this Section.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

Advisory 224.1 General. Certain facilities used for transient lodging, including time shares, dormitories, and town homes may be covered by both these requirements and the Fair Housing Amendments Act. The Fair Housing Amendments Act requires that certain residential structures having four or more multifamily dwelling units, regardless of whether they are privately owned or federally assisted, include certain features of accessible and adaptable design according to guidelines established by the U.S. Department of Housing and Urban Development (HUD). This law and the appropriate regulations should be consulted before proceeding with the design and construction of residential housing.

Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1 require vertical access to all levels. Florida requirements may be waived down to the ADA Standards requirements.

224.1.1 Alterations. Where guestrooms are altered or added, the requirements of this Section shall apply only to the guestrooms being altered or added until the number of guestrooms complies with the minimum number required for new construction.

Advisory 224.1.1 Alterations. In alterations and additions, the minimum required number of accessible guestrooms is based on the total number of guestrooms altered or added instead of the total number of guestrooms provided in a facility. Typically, each alteration of a facility is limited to a particular portion of the facility. When accessible guestrooms are added as a result of subsequent alterations, compliance with Subsection 224.5 (Dispersion) is more likely to be achieved if all of the accessible guestrooms are not provided in the same area of the facility.

224.1.2 Guestroom doors and doorways. Entrances, doors, and doorways providing user passage into and within guestrooms that are not required to provide mobility features complying with Subsection 806.2 shall comply with Subsection 404.2.3.

Exception: Shower and sauna doors in guestrooms that are not required to provide mobility features complying with Subsection 806.2 shall not be required to comply with Subsection 404.2.3.

Advisory 224.1.2 Guestroom doors and doorways. Because of the social interaction that often occurs in lodging facilities, an accessible clear opening width is required for doors and doorways to and within all guestrooms, including those not required to be accessible. This applies to all doors, including bathroom doors, that allow full user passage. Other requirements for doors and doorways in Section 404 do not apply to guestrooms not required to provide mobility features.

224.2 Guestrooms with mobility features. In transient lodging facilities, guestrooms with mobility features complying with Subsection 806.2 shall be provided in accordance with Table 224.2.

224.3 Beds. In guestrooms having more than 25 beds, 5 percent minimum of the beds shall have clear floor space complying with Subsection 806.2.3.

224.4 Guestrooms with communication features. In transient lodging facilities, guestrooms with communication features complying with Subsection 806.3 shall be provided in accordance with Table 224.4.

TABLE 224.4
GUESTROOMS WITH COMMUNICATION FEATURES

TOTAL NUMBER OF GUESTROOMS PROVIDED	MINIMUM NUMBER OF REQUIRED GUESTROOMS WITH COMMUNICATION FEATURES
2 to 25	2
26 to 50	4
51 to 75	7
76 to 100	9
101 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
501 to 1,000	5 percent of total
1,001 and over	50, plus 3 for each 100 over 1,000

224.5 Dispersion. Guestrooms required to provide mobility features complying with Subsection 806.2 and guestrooms required to provide communication features complying with Subsection 806.3 shall be dispersed among the various classes of guestrooms, and shall provide choices of types of guestrooms, number of beds, and other amenities comparable to the choices provided to other guests. Where the minimum number of guestrooms required to comply with Section 806 is not sufficient to allow for complete dispersion, guestrooms shall be dispersed in the following priority: guestroom type, number of beds, and amenities. At least one guestroom required to provide mobility features complying with Subsection 806.2 shall also provide communication features complying with Subsection 806.3. Not more than 10 percent of guestrooms required to provide mobility features complying with Subsection 806.2 shall be used to satisfy the minimum number of guestrooms required to provide communication features complying with Subsection 806.3.

Advisory 224.5 Dispersion. Factors to be considered in providing an equivalent range of options may include, but are not limited to, room size, bed size, cost, view, bathroom fixtures such as hot tubs and spas, smoking and nonsmoking, and the number of rooms provided.

224.6 Places of lodging. Places of lodging shall comply with the requirements for transient lodging guestrooms in this Section and Section 806.

Exception: Alterations to guestrooms in places of lodging where the guestrooms are not owned or substantially controlled by the entity that owns, leases, or operates the overall facility and the physical features of the guestroom interiors are controlled by their individual owners are not required to comply with Section 36.402, F.S., or the alterations requirements in Section 224.1.1.

224.6.1 Guestrooms. Guestrooms with mobility features shall be provided as follows: (i) Facilities that are subject to the same permit application on a common site that each have 50 or fewer guestrooms may be combined for the purposes of determining the required number of accessible rooms and type of accessible bathing facility in accordance with Table 224.2; (ii) Facilities with more than 50 guestrooms shall be treated separately for the purposes of determining the required number of accessible rooms and type of accessible bathing facility in accordance with Table 224.2.

224.6.2 Facilities with residential units and transient lodging units. Residential dwelling units that are designed and constructed for residential use exclusively are not subject to the transient lodging standards.

224.6.3 Buildings, structures, or facilities licensed as a hotel, motel, or condominium pursuant to Chapter

509, F.S. All buildings, structures, or facilities licensed as a hotel, motel, or condominium pursuant to Chapter 509, F.S., a number of rooms equaling at least 5 percent of the guestrooms minus the Total Number of Required (accessible) Rooms required by Table 224.2 shall provide special accessibility features of Subsection 806.4.

224.7 Housing at a place of education. Housing at a place of education shall comply with the requirements for transient lodging guestrooms in this Section and Section 806, subject to the following exceptions. The term “sleeping room” is intended to be used interchangeably with the term “guestroom” as it is used in the transient lodging standards.

Exceptions:

1. Kitchens within housing units containing accessible sleeping rooms with mobility features (including suites and clustered sleeping rooms) or on floors containing accessible sleeping rooms with mobility features shall provide turning spaces that comply with Subsection 809.2.2 and kitchen work surfaces that comply with Subsection 804.3.
2. Multibedroom housing units containing accessible sleeping rooms with mobility features shall have an accessible route throughout the unit in accordance with Subsection 809.2.
3. Apartments or townhouse facilities that are provided by or on behalf of a place of education, which are leased on a year-round basis exclusively to graduate students or faculty and do not contain any public use or common use areas available for educational programming, are not subject to the transient lodging standards and shall comply with the requirements for residential facilities in Sections 233 and 809.

**TABLE 224.2
GUESTROOMS WITH MOBILITY FEATURES**

	MINIMUM NUMBER OF REQUIRED ROOMS WITHOUT ROLL-IN SHOWERS	MINIMUM NUMBER OF REQUIRED ROOMS WITH ROLL-IN SHOWERS	TOTAL NUMBER OF REQUIRED ROOMS	FLORIDA 5%
1 to 25	1	0	1	See Subsection 224.6.3
26 to 50	2	0	2	
51 to 75	3	1	4	
76 to 100	4	1	5	
101 to 150	5	2	7	
151 to 200	6	2	8	
201 to 300	7	3	10	
301 to 400	8	4	12	
401 to 500	9	4	13	
501 to 1,000	2 percent of total	1 percent of total	3 percent of total	
1,001 and over	20, plus 1 for each 100, or fraction thereof, over 1,000	10, plus 1 for each 100, or fraction thereof, over 1,000	30, plus 2 for each 100, or fraction thereof, over 1,000	

SECTION 225 STORAGE

225.1 General. Storage facilities shall comply with this Section.

225.2 Storage. Where storage is provided in accessible spaces, at least one of each type shall comply with Section 811.

Advisory 225.2 Storage. Types of storage include, but are not limited to, closets, cabinets, shelves, clothes rods, hooks, and drawers. Where provided, at least one of each type of storage must be within the reach ranges specified in Section 308; however, it is permissible to install additional storage outside the reach ranges.

225.2.1 Lockers. Where lockers are provided, at least 5 percent, but no fewer than one of each type, shall comply with Section 811.

Advisory 225.2.1 Lockers. Different types of lockers may include full-size and half-size lockers, as well as those specifically designed for storage of various sports equipment.

225.2.2 Self-service shelving. Self-service shelves shall be located on an accessible route complying with Section 402. Self-service shelving shall not be required to comply with Section 308.

Advisory 225.2.2 Self-service shelving. Self-service shelves include, but are not limited to, library, store, or post office shelves.

225.3 Self-service storage facilities. Self-service storage facilities shall provide individual self-service storage spaces complying with these requirements in accordance with Table 225.3.

Advisory 225.3 Self-service storage facilities. Although there are no technical requirements that are unique to self-service storage facilities, elements and spaces provided in facilities containing self-service storage spaces required to comply with these requirements must comply with this Code where applicable. For example: the number of storage spaces required to comply with these requirements must provide accessible Routes complying with Section 206; Accessible Means of Egress complying with Section 207; Parking Spaces complying with Section 208; and, where provided, other public use or common use elements and facilities such as toilet rooms, drinking fountains, and telephones must comply with the applicable requirements of this Code.

**TABLE 225.3
SELF-SERVICE STORAGE FACILITIES**

TOTAL SPACES IN FACILITY	MINIMUM NUMBER OF SPACES REQUIRED TO BE ACCESSIBLE
1 to 200	5 percent, but no fewer than 1
201 and over	10, plus 2 percent of total number of units over 200

225.3.1 Dispersion. Individual self-service storage spaces shall be dispersed throughout the various classes of spaces

provided. Where more classes of spaces are provided than the number required to be accessible, the number of spaces shall not be required to exceed that required by Table 225.3. Self-service storage spaces complying with Table 225.3 shall not be required to be dispersed among buildings in a multibuilding facility.

SECTION 226 DINING SURFACES AND WORK SURFACES

226.1 General. Where dining surfaces are provided for the consumption of food or drink, at least 5 percent of the seating spaces and standing spaces at the dining surfaces shall comply with Section 902. In addition, where work surfaces are provided for use by other than employees, at least 5 percent shall comply with Section 902.

Exceptions:

1. Sales counters and service counters shall not be required to comply with Section 902.
2. Check writing surfaces provided at check-out aisles not required to comply with Subsection 904.3 shall not be required to comply with Section 902.

Advisory 226.1 General. In facilities covered by the ADA, this requirement does not apply to work surfaces used only by employees. However, the ADA and, where applicable, Section 504 of the Rehabilitation Act of 1973, as amended, provide that employees are entitled to “reasonable accommodations.” With respect to work surfaces, this means that employers may need to procure or adjust work stations such as desks, laboratory and work benches, fume hoods, reception counters, teller windows, study carrels, commercial kitchen counters, and conference tables to accommodate the individual needs of employees with disabilities on an “as needed” basis. Consider work surfaces that are flexible and permit installation at variable heights and clearances.

226.2 Dispersion. Dining surfaces and work surfaces required to comply with Section 902 shall be dispersed throughout the space or facility containing dining surfaces and work surfaces.

SECTION 227 SALES AND SERVICE

227.1 General. Where provided, check-out aisles, sales counters, service counters, food service lines, queues, and waiting lines shall comply with this Section and Section 904.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

227.2 Check-out aisles. Where check-out aisles are provided, check-out aisles complying with Subsection 904.3 shall be provided in accordance with Table 227.2. Where check-out aisles serve different functions, check-out aisles complying with Subsection 904.3 shall be provided in accordance with Table 227.2 for each function. Where check-out aisles are dispersed throughout the building or facility, check-out aisles complying with Subsection 904.3 shall be dispersed.

Exception: Where the selling space is under 5,000 square feet no more than one check-out aisle complying with Subsection 904.3 shall be required.

**TABLE 227.2
CHECK-OUT AISLES**

NUMBER OF CHECK-OUT AISLES OF EACH FUNCTION	MINIMUM NUMBER OF CHECK-OUT AISLES OF EACH FUNCTION REQUIRED TO COMPLY WITH SUBSECTION 904.3
1 to 4	1
5 to 8	2
9 to 15	3
16 and over	3, plus 20 percent of additional aisles

227.2.1 Altered check-out aisles. Where check-out aisles are altered, at least one of each check-out aisle serving each function shall comply with Subsection 904.3 until the number of check-out aisles complies with Subsection 227.2.

227.3 Counters. Where provided, at least one of each type of sales counter and service counter shall comply with Subsection 904.4. Where counters are dispersed throughout the building or facility, counters complying with Subsection 904.4 also shall be dispersed.

Advisory 227.3 Counters. Types of counters that provide different services in the same facility include, but are not limited to, order, pick-up, express, and returns. One continuous counter can be used to provide different types of service. For example, order and pick-up are different services. It would not be acceptable to provide access only to the part of the counter where orders are taken when orders are picked-up at a different location on the same counter. Both the order and pick-up section of the counter must be accessible.

227.4 Food service lines. Food service lines shall comply with Subsection 904.5. Where self-service shelves are provided, at least 50 percent, but no fewer than one, of each type provided shall comply with Section 308.

227.5 Queues and waiting lines. Queues and waiting lines servicing counters or check-out aisles required to comply with Subsection 904.3 or 904.4 shall comply with Section 403.

SECTION 228 DEPOSITORIES, VENDING MACHINES, CHANGE MACHINES, MAIL BOXES, AND FUEL DISPENSERS

228.1 General. Where provided, at least one of each type of depository, vending machine, change machine, and fuel dispenser shall comply with Section 309.

Exception: Drive-up only depositories shall not be required to comply with Section 309.

Advisory 228.1 General. Depositories include, but are not limited to, night receptacles in banks, post offices, video stores, and libraries.

228.2 Mail boxes. Where mail boxes are provided in an interior location, at least 5 percent, but no fewer than one, of each type shall comply with Section 309. In residential facilities, where mail boxes are provided for each residential dwelling unit, mail boxes complying with Section 309 shall be provided for each residential dwelling unit required to provide mobility features complying with Subsections 809.2 through 809.4.

SECTION 229 WINDOWS

229.1 General. Where glazed openings are provided in accessible rooms or spaces for operation by occupants, at least one opening shall comply with Section 309. Each glazed opening required by an administrative authority to be operable shall comply with Section 309.

Exception:

1. Glazed openings in residential dwelling units required to comply with Section 809 shall not be required to comply with this Section.
2. Glazed openings in guestrooms required to provide communication features and in guestrooms required to comply with Subsection 206.5.3 shall not be required to comply with this Section.

SECTION 230 TWO-WAY COMMUNICATION SYSTEMS

230.1 General. Where a two-way communication system is provided to gain admittance to a building or facility or to restricted areas within a building or facility, the system shall comply with Section 708.

Advisory 230.1 General. This requirement applies to facilities such as office buildings, courthouses, and other facilities where admittance to the building or restricted spaces is dependent on two-way communication systems.

SECTION 231 JUDICIAL FACILITIES

231.1 General. Judicial facilities shall comply with this Section.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

231.2 Courtrooms. Each courtroom shall comply with Section 808.

231.3 Holding cells. Where provided, central holding cells and court-floor holding cells shall comply with this Subsection.

231.3.1 Central holding cells. Where separate central holding cells are provided for adult male, juvenile male, adult female, or juvenile female, one of each type shall comply with Subsection 807.2. Where central holding cells are provided and are not separated by age or sex, at least one cell complying with Subsection 807.2 shall be provided.

231.3.2 Court-floor holding cells. Where separate court-floor holding cells are provided for adult male, juvenile male, adult female, or juvenile female, each courtroom shall be served by one cell of each type complying with Subsection 807.2. Where court-floor holding cells are provided and are not separated by age or sex, courtrooms shall be served by at least one cell complying with Subsection 807.2. Cells may serve more than one courtroom.

231.4 Visiting areas. Visiting areas shall comply with this Subsection.

231.4.1 Cubicles and counters. At least 5 percent, but no fewer than one, of cubicles shall comply with Section 902 on both the visitor and detainee sides. Where counters are provided, at least one shall comply with Subsection 904.4.2 on both the visitor and detainee sides.

Exception: The detainee side of cubicles or counters at noncontact visiting areas not serving holding cells required to comply with this Section shall not be required to comply with Section 902 or Subsection 904.4.2.

231.4.2 Partitions. Where solid partitions or security glazing separate visitors from detainees at least one of each type of cubicle or counter partition shall comply with Subsection 904.6.

SECTION 232 DETENTION FACILITIES AND CORRECTIONAL FACILITIES

232.1 General. Buildings, facilities, or portions thereof, in which people are detained for penal or correction purposes, or in which the liberty of the inmates is restricted for security reasons shall comply with this Section.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

Advisory 232.1 General. Detention facilities include, but are not limited to, jails, detention centers, and holding cells in police stations. Correctional facilities include, but are not limited to, prisons, reformatories, and correctional centers.

Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1 require vertical access to all levels of facilities. Florida requirements may be waived down to the ADA Standards requirements.

232.2 General holding cells and general housing cells. General holding cells and general housing cells shall be provided in accordance with this Subsection.

Exception: Alterations to cells shall not be required to comply except to the extent determined by Subsection 232.2.1, Exception 2.

Advisory 232.2 General holding cells and general housing cells. Accessible cells or rooms should be dispersed among different levels of security, housing categories, and holding classifications (e.g., male/female and adult/juvenile) to facilitate access. Many detention and correctional facilities are designed so that certain areas (e.g., “shift” areas) can be adapted to serve as different types of housing

according to need. For example, a shift area serving as a medium-security housing unit might be redesignated for a period of time as a high-security housing unit to meet capacity needs. Placement of accessible cells or rooms in shift areas may allow additional flexibility in meeting requirements for dispersion of accessible cells or rooms.

Advisory 232.2 General holding cells and general housing cells exception. Although these requirements do not specify that cells be accessible as a consequence of an alteration, title II of the ADA requires that each service, program, or activity conducted by a public entity, when viewed in its entirety, be readily accessible to and usable by individuals with disabilities. This requirement must be met unless doing so would fundamentally alter the nature of a service, program, or activity or would result in undue financial and administrative burdens.

232.2.1 Cells with mobility features. At least 2 percent, but no fewer than one, of the total number of cells in a facility shall provide mobility features complying with Subsection 807.2.

Exceptions:

1. New construction of jails, prisons, and other detention and correctional facilities by public entities shall provide accessible mobility features complying with Subsection 807.2 for a minimum of 3 percent, but no fewer than one, of the total number of cells in a facility. Cells with mobility features shall be provided in each classification level.
2. Alterations to detention and correctional facilities. Alterations to jails, prisons, and other detention and correctional facilities by public entities shall provide accessible mobility features complying with Subsection 807.2 for a minimum of 3 percent, but no fewer than one, of the total number of cells being altered until at least 3 percent, but no fewer than one, of the total number of cells in a facility shall provide mobility features complying with Subsection 807.2. Altered cells with mobility features shall be provided in each classification level. However, when alterations are made to specific cells, detention and correctional facility operators may satisfy their obligation to provide the required number of cells with mobility features by providing the required mobility features in substitute cells (cells other than those where alterations are originally planned), provided that each substitute cell: (i) is located within the same prison site; (ii) Is integrated with other cells to the maximum extent feasible; (iii) Has, at a minimum, equal physical access as the altered cells to areas used by inmates or detainees for visitation, dining, recreation, educational programs, medical services, work programs, religious services, and participation in other programs that the facility offers to inmates or detainees; and, (iv) If it is technically infeasible to locate a substitute cell within the same prison site, a substitute cell must be provided at another prison site within the corrections system.

232.2.1.1 Beds. In cells having more than 25 beds, at least 5 percent of the beds shall have clear floor space complying with Subsection 807.2.3.

232.2.2 Cells with communication features. At least 2 percent, but no fewer than one, of the total number of general holding cells and general housing cells equipped with audible emergency alarm systems and permanently installed telephones within the cell shall provide communication features complying with Subsection 807.3.

232.3 Special holding cells and special housing cells.

Where special holding cells or special housing cells are provided, at least one cell serving each purpose shall provide mobility features complying with Subsection 807.2. Cells subject to this requirement include, but are not limited to, those used for purposes of orientation, protective custody, administrative or disciplinary detention or segregation, detoxification, and medical isolation.

Exception: Alterations to cells shall not be required to comply except to the extent determined by the Attorney General.

232.4 Medical care facilities. Patient bedrooms or cells required to comply with Section 223 shall be provided in addition to any medical isolation cells required to comply with Subsection 232.3.

232.4.1 Medical and long-term care facilities in jails, prisons, and other detention and correctional facilities. Public entities shall comply with Section 223 irrespective of whether those facilities are licensed.

232.5 Visiting areas. Visiting areas shall comply with this Subsection.

232.5.1 Cubicles and counters. At least 5 percent, but no fewer than one, of cubicles shall comply with Section 902 on both the visitor and detainee sides. Where counters are provided, at least one shall comply with this Section on both the visitor and detainee or inmate sides.

Exception: The inmate or detainee side of cubicles or counters at noncontact visiting areas not serving holding cells or housing cells required to comply with this Section shall not be required to comply with Section 902 or Subsection 904.4.2.

232.5.2 Partitions. Where solid partitions or security glazing separate visitors from detainees or inmates at least one of each type of cubicle or counter partition shall comply with Subsection 904.6.

SECTION 233 RESIDENTIAL FACILITIES

233.1 General. Facilities with residential dwelling units shall comply with this Section.

Notwithstanding the requirements of this Section, Subsection 201.1.1 shall apply.

Advisory 233.1 General. This Section outlines the requirements for residential facilities subject to the Americans with Disabilities Act of 1990. The facilities covered by this Section, as well as other facilities not covered by this Section,

may still be subject to other Federal laws such as the Fair Housing Act and Section 504 of the Rehabilitation Act of 1973, as amended. For example, the Fair Housing Act requires that certain residential structures having four or more multifamily dwelling units, regardless of whether they are privately owned or federally assisted, include certain features of accessible and adaptable design according to guidelines established by the U.S. Department of Housing and Urban Development (HUD). These laws and the appropriate regulations should be consulted before proceeding with the design and construction of residential facilities.

Florida law Section 553.504(2), F.S., incorporated in Subsection 233.3.6 establishes bathroom requirements for all new single-family houses, duplexes, triplexes, condominiums, and townhouses.

Residential facilities containing residential dwelling units provided by entities subject to HUD's Section 504 regulations and residential dwelling units covered by Subsection 233.3 must comply with the technical and scoping requirements in Chapters 1 through 10 included in this Code. This Section is not a stand-alone section; this Section only addresses the minimum number of residential dwelling units within a facility required to comply with Chapter 8. However, residential facilities must also comply with the requirements of this Code. For example: Subsection 206.5.4 requires all doors and doorways providing user passage in residential dwelling units providing mobility features to comply with Section 404; Subsection 206.7.6 permits platform lifts to be used to connect levels within residential dwelling units providing mobility features; Section 208 provides general scoping for accessible parking and Subsection 208.2.3.1 specifies the required number of accessible parking spaces for each residential dwelling unit providing mobility features; Subsection 228.2 requires mail boxes to be within reach ranges when they serve residential dwelling units providing mobility features; play areas are addressed in Section 240; and swimming pools are addressed in Section 242. There are special provisions applicable to facilities containing residential dwelling units at: Exception 3 to Subsection 202.3; Exception to Subsection 202.4; 203.8; and Exception 4 to Subsection 206.2.3.

Florida vertical accessibility requirements of Section 553.509, F.S., as incorporated in Subsection 201.1.1 require vertical access to all levels for accessible units. Florida requirements may be waived down to the ADA Standards requirements.

233.2 Residential dwelling units provided by entities subject to HUD Section 504 Regulations. Where facilities with residential dwelling units are provided by entities subject to regulations issued by the Department of Housing and Urban Development (HUD) under Section 504 of the Rehabilitation Act of 1973, as amended, such entities shall provide residential dwelling units with mobility features complying with Subsections 809.2 through 809.4 in a number required by the applicable HUD regulations. Residential dwelling units required to provide mobility features complying with Subsections 809.2 through 809.4 shall be on an accessible route as required by Section 206. In addition, such entities shall pro-

vide residential dwelling units with communication features complying with Subsection 809.5 in a number required by the applicable HUD regulations. Entities subject to this Subsection shall not be required to comply with Subsection 233.3.

Advisory 233.2 Residential dwelling units provided by entities subject to HUD Section 504 Regulations. This Subsection requires that entities subject to HUD's regulations implementing Section 504 of the Rehabilitation Act of 1973, as amended, provide residential dwelling units containing mobility features and residential dwelling units containing communication features complying with these regulations in a number specified in HUD's Section 504 regulations. Further, the residential dwelling units provided must be dispersed according to HUD's Section 504 criteria. In addition, this Subsection defers to HUD the specification of criteria by which the technical requirements of this Code will apply to alterations of existing facilities subject to HUD's Section 504 regulations.

233.3 Residential dwelling units provided by entities not subject to HUD Section 504 Regulations. Facilities with residential dwelling units provided by entities not subject to regulations issued by the Department of Housing and Urban Development (HUD) under Section 504 of the Rehabilitation Act of 1973, as amended, shall comply with this Subsection.

233.3.1 Minimum number: new construction. Newly constructed facilities with residential dwelling units shall comply with this Subsection.

Exception: Where facilities contain 15 or fewer residential dwelling units, the requirements of Subsections 233.3.1.1 and 233.3.1.2 shall apply to the total number of residential dwelling units that are constructed under a single contract, or are developed as a whole, whether or not located on a common site.

233.3.1.1 Residential dwelling units with mobility features. In facilities with residential dwelling units, at least 5 percent, but no fewer than one unit, of the total number of residential dwelling units shall provide mobility features complying with Subsections 809.2 through 809.4 and shall be on an accessible route as required by Section 206.

233.3.1.2 Residential dwelling units with communication features. In facilities with residential dwelling units, at least 2 percent, but no fewer than one unit, of the total number of residential dwelling units shall provide communication features complying with Subsection 809.5.

233.3.2 Residential dwelling units for sale. Residential dwelling units offered for sale shall provide accessible features to the extent required by regulations issued for Section 504 of the Rehabilitation Act of 1973, as amended.

Residential dwelling units designed and constructed or altered by public entities that will be offered for sale to

individuals shall comply with the requirements for residential facilities in this Section and Section 809.

Advisory 233.3.2 Residential dwelling for sale. DOJ regulation 28 CFR 35.1511(j)(2), for public entities (Title II) adds the following clarification regarding construction of dwelling units for sale to preselected buyers with disabilities: "The requirements of paragraph (1) also apply to housing programs that are operated by public entities where design and construction of particular residential dwelling units take place only after a specific buyer has been identified. In such programs, the covered entity must provide the units that comply with the requirements for accessible features to those pre-identified buyers with disabilities who have requested such a unit."

233.3.3 Additions. Where an addition to an existing building results in an increase in the number of residential dwelling units, the requirements of Subsection 233.3.1 shall apply only to the residential dwelling units that are added until the total number of residential dwelling units complies with the minimum number required by Subsection 233.3.1. Residential dwelling units required to comply with Subsection 233.3.1.1 shall be on an accessible route as required by Section 206.

233.3.4 Alterations. Alterations shall comply with this Subsection.

Exception: Where compliance with Subsection 809.2, 809.3, or 809.4 is technically infeasible, or where it is technically infeasible to provide an accessible route to a residential dwelling unit, the entity shall be permitted to alter or construct a comparable residential dwelling unit to comply with Subsections 809.2 through 809.4 provided that the minimum number of residential dwelling units required by Subsections 233.3.1.1 and 233.3.1.2, as applicable, is satisfied.

Advisory 233.3.4 Alterations exception. A substituted dwelling unit must be comparable to the dwelling unit that is not made accessible. Factors to be considered in comparing one dwelling unit to another should include the number of bedrooms; amenities provided within the dwelling unit; types of common spaces provided within the facility; and location with respect to community resources and services, such as public transportation and civic, recreational, and mercantile facilities.

233.3.4.1 Alterations to vacated buildings. Where a building is vacated for the purposes of alteration, and the altered building contains more than 15 residential dwelling units, at least 5 percent of the residential dwelling units shall comply with Subsections 809.2 through 809.4 and shall be on an accessible route as required by Section 206. In addition, at least 2 percent of the residential dwelling units shall comply with Subsection 809.5.

Advisory 233.3.4.1 Alterations to vacated buildings. This provision is intended to apply where a building is vacated with the intent to alter the building. Buildings that are vacated solely for pest control or asbestos removal are not subject to the requirements to provide residential dwelling units with mobility features or communication features.

233.3.4.2 Alterations to individual residential dwelling units. In individual residential dwelling units, where a bathroom or a kitchen is substantially altered, and at least one other room is altered, the requirements of Subsection 233.3.1 shall apply to the altered residential dwelling units until the total number of residential dwelling units complies with the minimum number required by Subsections 233.3.1.1 and 233.3.1.2. Residential dwelling units required to comply with Subsection 233.3.1.1 shall be on an accessible route as required by Section 206.

Exception: Where facilities contain 15 or fewer residential dwelling units, the requirements of Subsections 233.3.1.1 and 233.3.1.2 shall apply to the total number of residential dwelling units that are altered under a single contract, or are developed as a whole, whether or not located on a common site.

Advisory 233.3.4.2 Alterations to individual residential dwelling units. This Subsection uses the terms “substantially altered” and “altered.” A substantial alteration to a kitchen or bathroom includes, but is not limited to, alterations that are changes to or rearrangements in the plan configuration, or replacement of cabinetry. Substantial alterations do not include normal maintenance or appliance and fixture replacement, unless such maintenance or replacement requires changes to or rearrangements in the plan configuration, or replacement of cabinetry. The term “alteration” is defined both in Section 106 of these requirements and in the Department of Justice ADA regulations.

233.3.5 Dispersion. Residential dwelling units required to provide mobility features complying with Subsections 809.2 through 809.4 and residential dwelling units required to provide communication features complying with Subsection 809.5 shall be dispersed among the various types of residential dwelling units in the facility and shall provide choices of residential dwelling units comparable to, and integrated with, those available to other residents.

Exception: Where multistory residential dwelling units are one of the types of residential dwelling units provided, one-story residential dwelling units shall be permitted as a substitute for multistory residential dwelling units where equivalent spaces and amenities are provided in the one-story residential dwelling unit.

233.3.6 All new single-family houses, duplexes, triplexes, condominiums, and townhouses shall provide at least one bathroom, located with maximum possible privacy, where bathrooms are provided on habitable grade levels, with a door that has a 29-inch clear opening. However, if only a toilet room is provided at grade level, such toilet room shall have a clear opening of at least 29 inches.

233.4 Social service center establishments. Group homes, halfway houses, shelters, or similar social service center establishments that provide either temporary sleeping accommodations or residential dwelling units shall comply with the provisions applicable to residential facilities in this Section and Section 809.

233.4.1 In sleeping rooms with more than 25 beds, a minimum of 5 percent of the beds shall have clear floor space complying with Subsection 806.2.3.

233.4.2 Facilities with more than 50 beds covered that provide common use bathing facilities shall provide at least one roll-in shower with a seat that complies with Section 608. Transfer-type showers are not permitted in lieu of a roll-in shower with a seat, and the exceptions in Subsections 608.3 and 608.4 for residential dwelling units are not permitted. When separate shower facilities are provided for men and for women, at least one roll-in shower shall be provided for each group.

233.5 Apartments or townhouse facilities provided by or on behalf of a place of education. Apartments or townhouse facilities that are provided by or on behalf of a place of education, which are leased on a year-round basis exclusively to graduate students or faculty and do not contain any public use or common use areas available for educational programming shall comply with the requirements for residential facilities in this Section and Section 809.

233.6 Residential dwelling units designed and constructed or altered by public entities that will be offered for sale to individuals. Residential dwelling units designed and constructed or altered by public entities that will be offered for sale to individuals shall comply with the requirements for residential facilities in this Section and Section 809.

SECTION 234 AMUSEMENT RIDES

234.1 General. Amusement rides shall comply with this Section.

Exception: Mobile or portable amusement rides shall not be required to comply with this Section.

Advisory 234.1 General. These requirements apply generally to newly designed and constructed amusement rides and attractions. A custom designed and constructed ride is new upon its first use, which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, new refers to the first permanent installation of the ride, whether it is used off the shelf or modified before it is installed. Where amusement rides are moved after several seasons to another area of the park or to another park, the ride would not be considered newly designed or newly constructed.

Some amusement rides and attractions that have unique designs and features are not addressed by these requirements. In those situations, these requirements are to be applied to the extent possible. An example of an amusement

ride not specifically addressed by these requirements includes “virtual reality” rides where the device does not move through a fixed course within a defined area. An accessible route must be provided to these rides. Where an attraction or ride has unique features for which there are no applicable scoping provisions, then a reasonable number, but at least one, of the features must be located on an accessible route. Where there are appropriate technical provisions, they must be applied to the elements that are covered by the scoping provisions.

Advisory 234.1 General exception. Mobile or temporary rides are those set up for short periods of time such as traveling carnivals, State and county fairs, and festivals. The amusement rides that are covered by this Subsection are ones that are not regularly assembled and disassembled.

234.2 Load and unload areas. Load and unload areas serving amusement rides shall comply with Subsection 1002.3.

234.3 Minimum number. Amusement rides shall provide at least one wheelchair space complying with Subsection 1002.4, or at least one amusement ride seat designed for transfer complying with Subsection 1002.5, or at least one transfer device complying with Subsection 1002.6.

Exceptions:

1. Amusement rides that are controlled or operated by the rider shall not be required to comply with this Subsection.
2. Amusement rides designed primarily for children, where children are assisted on and off the ride by an adult, shall not be required to comply this Subsection.
3. Amusement rides that do not provide amusement ride seats shall not be required to comply with this Subsection.

Advisory 234.3 Minimum number Exceptions 1 through 3. Amusement rides controlled or operated by the rider, designed for children, or rides without ride seats are not required to comply with this Subsection. These rides are not exempt from the other provisions in this Subsection requiring an accessible route to the load and unload areas and to the ride. The exception does not apply to those rides where patrons may cause the ride to make incidental movements, but where the patron otherwise has no control over the ride.

Advisory 234.3 Minimum number Exception 2. The exception is limited to those rides designed “primarily” for children, where children are assisted on and off the ride by an adult. This exception is limited to those rides designed for children and not for the occasional adult user. An accessible route to and turning space in the load and unload area will provide access for adults and family members assisting children on and off these rides.

234.4 Existing amusement rides. Where existing amusement rides are altered, the alteration shall comply with this Subsection.

Advisory 234.4 Existing amusement rides. Routine maintenance, painting, and changing of theme boards are examples of activities that do not constitute an alteration subject to this Section.

234.4.1 Load and unload areas. Where load and unload areas serving existing amusement rides are newly designed and constructed, the load and unload areas shall comply with Subsection 1002.3.

234.4.2 Minimum number. Where the structural or operational characteristics of an amusement ride are altered to the extent that the amusement ride’s performance differs from that specified by the manufacturer or the original design, the amusement ride shall comply with Subsection 234.3.

SECTION 235 RECREATIONAL BOATING FACILITIES

235.1 General. Recreational boating facilities shall comply with this Section.

235.2 Boat slips. Boat slips complying with Subsection 1003.3.1 shall be provided in accordance with Table 235.2. Where the number of boat slips is not identified, each 40 feet of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for the purpose of this Section.

**TABLE 235.2
BOAT SLIPS**

TOTAL NUMBER OF BOAT SLIPS PROVIDED IN FACILITY	MINIMUM NUMBER OF REQUIRED ACCESSIBLE BOAT SLIPS
1 to 25	1
26 to 50	2
51 to 100	3
101 to 150	4
151 to 300	5
301 to 400	6
401 to 500	7
501 to 600	8
601 to 700	9
701 to 800	10
801 to 900	11
901 to 1,000	12
1,001 and over	12, plus 1 for every 100, or fraction thereof, over 1,000

Advisory 235.2 Boat slips. The requirement for boat slips also applies to piers where boat slips are not demarcated. For example, a single pier 25 feet long and 5 feet wide (the minimum width specified by Subsection 1003.3) allows boats to moor on three sides. Because the number of boat slips is not demarcated, the total length of boat slip edge (55 feet) must be used to determine the number of boat slips provided (two). This number is based on the specification in this Subsection that each 40 feet of boat slip edge, or fraction thereof, counts as one boat slip. In this example, Table 235.2 would require one boat slip to be accessible.

235.2.1 Dispersion. Boat slips complying with Subsection 1003.3.1 shall be dispersed throughout the various types of boat slips provided. Where the minimum number of boat slips required to comply with Subsection 1003.3.1 has been met, no further dispersion shall be required.

Advisory 235.2.1 Dispersion. Types of boat slips are based on the size of the boat slips; whether single berths or double berths, shallow water or deep water, transient or longer-term lease, covered or uncovered; and whether slips are equipped with features such as telephone, water, electricity or cable connections. The term “boat slip” is intended to cover any pier area other than launch ramp boarding piers where recreational boats are moored for purposes of berthing, embarking, or disembarking. For example, a fuel pier may contain boat slips, and this type of short term slip would be included in determining compliance with Subsection 235.2.

235.3 Boarding piers at boat launch ramps. Where boarding piers are provided at boat launch ramps, at least 5 percent, but no fewer than one, of the boarding piers shall comply with Subsection 1003.3.2.

SECTION 236 EXERCISE MACHINES AND EQUIPMENT

236.1 General. At least one of each type of exercise machine and equipment shall comply with Subsection 1004.

Advisory 236.1 General. Most strength training equipment and machines are considered different types. Where operators provide a biceps curl machine and cable-cross-over machine, both machines are required to meet the provisions in this Section, even though an individual may be able to work on their biceps through both types of equipment.

Similarly, there are many types of cardiovascular exercise machines, such as stationary bicycles, rowing machines, stair climbers, and treadmills. Each machine provides a cardiovascular exercise and is considered a different type for purposes of these requirements.

SECTION 237 FISHING PIERS AND PLATFORMS

237.1 General. Fishing piers and platforms shall comply with Section 1005.

SECTION 238 GOLF FACILITIES

238.1 General. Golf facilities shall comply with this Section.

238.2 Golf courses. Golf courses shall comply with this Subsection.

238.2.1 Teeing grounds. Where one teeing ground is provided for a hole, the teeing ground shall be designed and constructed so that a golf car can enter and exit the teeing ground. Where two teeing grounds are provided for a hole, the forward teeing ground shall be designed and constructed so that a golf car can enter and exit the teeing

ground. Where three or more teeing grounds are provided for a hole, at least two teeing grounds, including the forward teeing ground, shall be designed and constructed so that a golf car can enter and exit each teeing ground.

Exception: In existing golf courses, the forward teeing ground shall not be required to be one of the teeing grounds on a hole designed and constructed so that a golf car can enter and exit the teeing ground where compliance is not feasible due to terrain.

238.2.2 Putting greens. Putting greens shall be designed and constructed so that a golf car can enter and exit the putting green.

238.2.3 Weather shelters. Where provided, weather shelters shall be designed and constructed so that a golf car can enter and exit the weather shelter and shall comply with Subsection 1006.4.

238.3 Practice putting greens, practice teeing grounds, and teeing stations at driving ranges. At least 5 percent, but no fewer than one, of practice putting greens, practice teeing grounds, and teeing stations at driving ranges shall be designed and constructed so that a golf car can enter and exit the practice putting greens, practice teeing grounds, and teeing stations at driving ranges.

SECTION 239 MINIATURE GOLF FACILITIES

239.1 General. Miniature golf facilities shall comply with this Section.

239.2 Minimum number. At least 50 percent of holes on miniature golf courses shall comply with Subsection 1007.3.

Advisory 239.2 Minimum number. Where possible, providing access to all holes on a miniature golf course is recommended. If a course is designed with the minimum 50 percent accessible holes, designers or operators are encouraged to select holes which provide for an equivalent experience to the maximum extent possible.

239.3 Miniature golf course configuration. Miniature golf courses shall be configured so that the holes complying with Subsection 1007.3 are consecutive. Miniature golf courses shall provide an accessible route from the last hole complying with Subsection 1007.3 to the course entrance or exit without requiring travel through any other holes on the course.

Exception: One break in the sequence of consecutive holes shall be permitted provided that the last hole on the miniature golf course is the last hole in the sequence.

Advisory 239.3 Miniature golf course configuration. Where only the minimum 50 percent of the holes are accessible, an accessible route from the last accessible hole to the course exit or entrance must not require travel back through other holes. In some cases, this may require an additional accessible route. Other options include increasing the number of accessible holes in a way that limits the distance needed to connect the last accessible hole with the course exit or entrance.

SECTION 240 PLAY AREAS

240.1 General. Play areas for children ages two and over shall comply with this Section. Where separate play areas are provided within a site for specific age groups, each play area shall comply with this Section.

Exceptions:

1. Play areas located in family child care facilities where the proprietor actually resides shall not be required to comply with this Section.
2. In existing play areas, where play components are relocated for the purposes of creating safe use zones and the ground surface is not altered or extended for more than one use zone, the play area shall not be required to comply with this Section.
3. Amusement attractions shall not be required to comply with this Section.
4. Where play components are altered and the ground surface is not altered, the ground surface shall not be required to comply with Subsection 1008.2.6 unless required by Subsection 202.4.

Advisory 240.1 General. Play areas may be located on exterior sites or within a building. Where separate play areas are provided within a site for children in specified age groups (e.g., preschool (ages two to five) and school age (ages five to 12)), each play area must comply with this Section. Where play areas are provided for the same age group on a site but are geographically separated (e.g., one is located next to a picnic area and another is located next to a softball field), they are considered separate play areas and each play area must comply with this Section.

240.1.1 Additions. Where play areas are designed and constructed in phases, the requirements of this Section shall apply to each successive addition so that when the addition is completed, the entire play area complies with all the applicable requirements of this Section.

Advisory 240.1.1 Additions. These requirements are to be applied so that when each successive addition is completed, the entire play area complies with all applicable provisions. For example, a play area is built in two phases. In the first phase, there are 10 elevated play components and 10 elevated play components are added in the second phase for a total of 20 elevated play components in the play area. When the first phase was completed, at least five elevated play components, including at least three different types, were to be provided on an accessible route. When the second phase is completed, at least 10 elevated play components must be located on an accessible route, and at least seven ground level play components, including four different types, must be provided on an accessible route. At the time the second phase is complete, ramps must be used to connect at least five of the elevated play components and transfer systems are permitted to be used to connect the rest of the elevated play components required to be located on an accessible route.

240.2 Play components. Where provided, play components shall comply with this Subsection.

240.2.1 Ground level play components. Ground level play components shall be provided in the number and types required by this Subsection. Ground level play components that are provided to comply with Subsection 240.2.1.1 shall be permitted to satisfy the additional number required by Subsection 240.2.1.2 if the minimum required types of play components are satisfied. Where two or more required ground level play components are provided, they shall be dispersed throughout the play area and integrated with other play components.

Advisory 240.2.1 Ground level play components. Examples of ground level play components may include spring rockers, swings, diggers, and stand-alone slides. When distinguishing between the different types of ground level play components, consider the general experience provided by the play component. Examples of different types of experiences include, but are not limited to, rocking, swinging, climbing, spinning, and sliding.

A spiral slide may provide a slightly different experience from a straight slide, but sliding is the general experience and therefore a spiral slide is not considered a different type of play component from a straight slide.

Ground level play components accessed by children with disabilities must be integrated into the play area. Designers should consider the optimal layout of ground level play components accessed by children with disabilities to foster interaction and socialization among all children. Grouping all ground level play components accessed by children with disabilities in one location is not considered integrated.

Where a stand-alone slide is provided, an accessible route must connect the base of the stairs at the entry point to the exit point of the slide. A ramp or transfer system to the top of the slide is not required. Where a sand box is provided, an accessible route must connect to the border of the sand box. Accessibility to the sand box would be enhanced by providing a transfer system into the sand or by providing a raised sand table with knee clearance complying with Subsection 1008.4.3.

Ramps are preferred over transfer systems since not all children who use wheelchairs or other mobility devices may be able to use, or may choose not to use, transfer systems. Where ramps connect elevated play components, the maximum rise of any ramp run is limited to 12 inches. Where possible, designers and operators are encouraged to provide ramps with a slope less than the 1:12 maximum. Berms or sculpted dirt may be used to provide elevation and may be part of an accessible route to composite play structures.

Platform lifts are permitted as a part of an accessible route. Because lifts must be independently operable, operators should carefully consider the appropriateness of their use in unsupervised settings.

240.2.1.1 Minimum number and types. Where ground level play components are provided, at least one of each type shall be on an accessible route and shall comply with Subsection 1008.4.

240.2.1.2 Additional number and types. Where elevated play components are provided, ground level play components shall be provided in accordance with Table 240.2.1.2 and shall comply with Subsection 1008.4.

Exception: If at least 50 percent of the elevated play components are connected by a ramp and at least three of the elevated play components connected by the ramp are different types of play components, the play area shall not be required to comply with this Subsection.

Advisory 240.2.1.2 Additional number and types. Where a large play area includes two or more composite play structures designed for the same age group, the total number of elevated play components on all the composite play structures must be added to determine the additional number and types of ground level play components that must be provided on an accessible route.

240.2.2 Elevated play components. Where elevated play components are provided, at least 50 percent shall be on an accessible route and shall comply with Subsection 1008.4.

Advisory 240.2.2 Elevated play components. A double or triple slide that is part of a composite play structure is one elevated play component. For purposes of this Section, ramps, transfer systems, steps, decks, and roofs are not considered elevated play components. Although socialization and pretend play can occur on these elements, they are not primarily intended for play.

Some play components that are attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck. For example, a climber attached to a composite play structure can be approached or exited at the ground level or above grade from

a platform or deck on a composite play structure. Play components that are attached to a composite play structure and can be approached from a platform or deck (e.g., climbers and overhead play components) are considered elevated play components. These play components are not considered ground level play components and do not count toward the requirements in Subsection 240.2.1.2 regarding the number of ground level play components that must be located on an accessible route.

SECTION 241 SAUNAS AND STEAM ROOMS

241 General. Where provided, saunas and steam rooms shall comply with Section 612.

Exception: Where saunas or steam rooms are clustered at a single location, no more than 5 percent of the saunas and steam rooms, but no fewer than one, of each type in each cluster shall be required to comply with Section 612.

SECTION 242 SWIMMING POOLS, WADING POOLS, AND SPAS

242.1 General. Swimming pools, wading pools, and spas shall comply with this Section.

242.2 Swimming pools. At least two accessible means of entry shall be provided for swimming pools. Accessible means of entry shall be swimming pool lifts complying with Subsection 1009.2; sloped entries complying with Subsection 1009.3; transfer walls complying with Subsection 1009.4; transfer systems complying with Subsection 1009.5; and pool stairs complying with Subsection 1009.6. At least one accessible means of entry provided shall comply with Subsection 1009.2 or 1009.3.

Exceptions:

1. Where a swimming pool has less than 300 linear feet of swimming pool wall, no more than one accessible means of entry shall be required provided that the accessible means of entry is a swimming pool lift

**TABLE 240.2.1.2
NUMBER AND TYPES OF GROUND LEVEL PLAY COMPONENTS REQUIRED TO BE ON ACCESSIBLE ROUTES**

NUMBER OF ELEVATED PLAY COMPONENTS PROVIDED	MINIMUM NUMBER OF GROUND LEVEL PLAY COMPONENTS REQUIRED TO BE ON AN ACCESSIBLE ROUTE	MINIMUM NUMBER OF DIFFERENT TYPES OF GROUND LEVEL PLAY COMPONENTS REQUIRED TO BE ON AN ACCESSIBLE ROUTE
1	Not applicable	Not applicable
2 to 4	1	1
5 to 7	2	2
8 to 10	3	3
11 to 13	4	3
14 to 16	5	3
17 to 19	6	3
20 to 22	7	4
23 to 25	8	4
26 and over	8, plus 1 for each additional 3, or fraction thereof, over 25	5

SCOPING REQUIREMENTS

complying with Subsection 1009.2 or sloped entry complying with Subsection 1009.3.

2. Wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area shall not be required to provide more than one accessible means of entry provided that the accessible means of entry is a swimming pool lift complying with Subsection 1009.2, a sloped entry complying with Subsection 1009.3, or a transfer system complying with Subsection 1009.5.
3. Catch pools shall not be required to provide an accessible means of entry provided that the catch pool edge is on an accessible route.

Advisory 242.2 Swimming pools. Where more than one means of access is provided into the water, it is recommended that the means be different. Providing different means of access will better serve the varying needs of people with disabilities in getting into and out of a swimming pool. It is also recommended that where two or more means of access are provided, they not be provided in the same location in the pool. Different locations will provide increased options for entry and exit, especially in larger pools.

Advisory 242.2 Swimming pools Exception 1. Pool walls at diving areas and areas along pool walls where there is no pool entry because of landscaping or adjacent structures are to be counted when determining the number of accessible means of entry required.

242.3 Wading pools. At least one accessible means of entry shall be provided for wading pools. Accessible means of entry shall comply with sloped entries complying with Subsection 1009.3.

242.4 Spas. At least one accessible means of entry shall be provided for spas. Accessible means of entry shall comply with swimming pool lifts complying with Subsection 1009.2; transfer walls complying with Subsection 1009.4; or transfer systems complying with Subsection 1009.5.

Exception: Where spas are provided in a cluster, no more than 5 percent, but no fewer than one, spa in each cluster shall be required to comply with this Subsection.

SECTION 243 SHOOTING FACILITIES WITH FIRING POSITIONS

243.1 General. Where shooting facilities with firing positions are designed and constructed at a site, at least 5 percent, but no fewer than one, of each type of firing position shall comply with Section 1010.

CHAPTER 3

BUILDING BLOCKS

SECTION 301 GENERAL

301.1 Scope. The provisions of Chapter 3 shall apply where required by Chapter 2 or where referenced by a requirement in this code.

SECTION 302 FLOOR OR GROUND SURFACES

302.1 General. Floor and ground surfaces shall be stable, firm, and slip resistant and shall comply with this Section.

Exceptions:

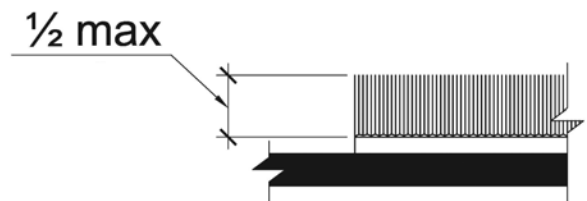
1. Within animal containment areas, floor and ground surfaces shall not be required to be stable, firm, and slip resistant.
2. Areas of sport activity shall not be required to comply with this Section.

Advisory 302.1 General. A stable surface is one that remains unchanged by contaminants or applied force, so that when the contaminant or force is removed, the surface returns to its original condition. A firm surface resists deformation by either indentations or particles moving on its surface. A slip-resistant surface provides sufficient frictional counterforce to the forces exerted in walking to permit safe ambulation.

302.2 Carpet. Carpet or carpet tile shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. Carpet or carpet tile shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be $\frac{1}{2}$ inch maximum. Exposed edges of carpet shall be

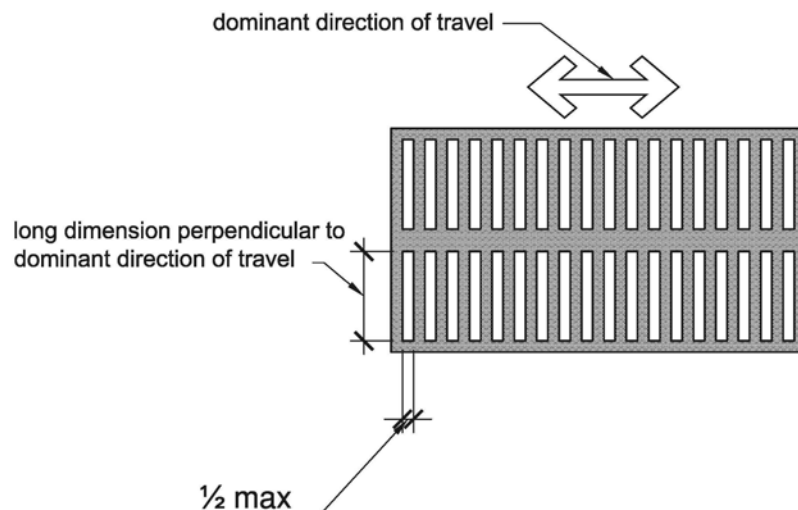
fastened to floor surfaces and shall have trim on the entire length of the exposed edge. Carpet edge trim shall comply with Section 303.

Advisory 302.2 Carpet. Carpets and permanently affixed mats can significantly increase the amount of force (roll resistance) needed to propel a wheelchair over a surface. The firmer the carpeting and backing, the lower the roll resistance. A pile thickness up to $\frac{1}{2}$ inch (measured to the backing, cushion, or pad) is allowed, although a lower pile provides easier wheelchair maneuvering. If a backing, cushion or pad is used, it must be firm. Preferably, carpet pad should not be used because the soft padding increases roll resistance.



**FIGURE 302.2
CARPET PILE HEIGHT**

302.3 Openings. Openings in floor or ground surfaces shall not allow passage of a sphere more than $\frac{1}{2}$ inch diameter except as allowed in Subsections 407.4.3, 409.4.3, 410.4, 810.5.3 and 810.10. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel.



**FIGURE 302.3
ELONGATED OPENINGS IN FLOOR OR GROUND SURFACES**

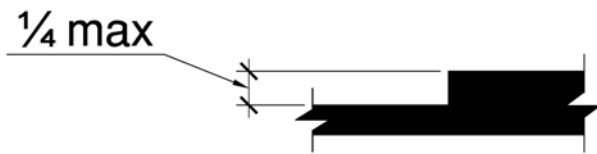
SECTION 303 CHANGES IN LEVEL

303.1 General. Where changes in level are permitted in floor or ground surfaces, they shall comply with this Section.

Exceptions:

1. Animal containment areas shall not be required to comply with this Section.
2. Areas of sport activity shall not be required to comply with this Section.

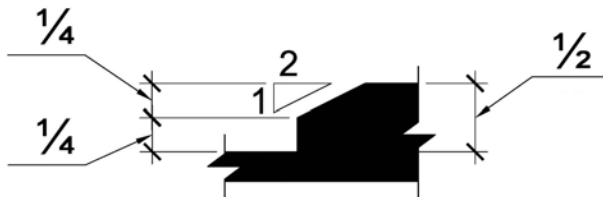
303.2 Vertical. Changes in level of $\frac{1}{4}$ inch high maximum shall be permitted to be vertical.



**FIGURE 303.2
VERTICAL CHANGE IN LEVEL**

303.3 Beveled. Changes in level between $\frac{1}{4}$ inch high minimum and $\frac{1}{2}$ inch high maximum shall be beveled with a slope not steeper than 1:2.

Advisory 303.3 Beveled. A change in level of $\frac{1}{2}$ inch is permitted to be $\frac{1}{4}$ inch vertical plus $\frac{1}{4}$ inch beveled. However, in no case may the combined change in level exceed $\frac{1}{2}$ inch. Changes in level exceeding $\frac{1}{2}$ inch must comply with Section 405 (Ramps) or 406 (Curb Ramps).



**FIGURE 303.3
BEVELED CHANGE IN LEVEL**

303.4 Ramps. Changes in level greater than $\frac{1}{2}$ inch high shall be ramped, and shall comply with Section 405 or 406.

SECTION 304 TURNING SPACE

304.1 General. Turning space shall comply with this Section.

304.2 Floor or ground surfaces. Floor or ground surfaces of a turning space shall comply with Section 302. Changes in level are not permitted.

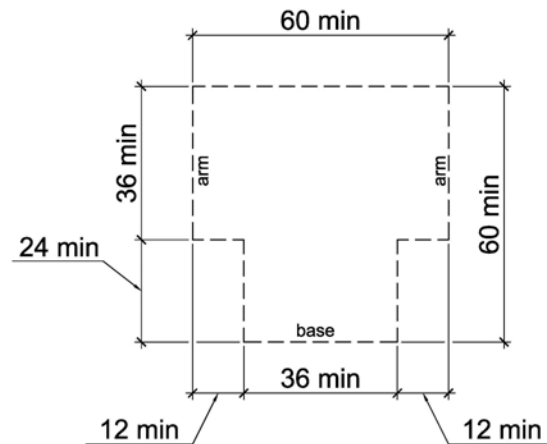
Exception: Slopes not steeper than 1:48 shall be permitted.

Advisory 304.2 Floor or ground surface exception. As used in this Section, the phrase “changes in level” refers to surfaces with slopes and to surfaces with abrupt rise exceeding that permitted in Subsection 303.3. Such changes in level are prohibited in required clear floor and ground spaces, turning spaces, and in similar spaces where people using wheelchairs and other mobility devices must park their mobility aids such as in wheelchair spaces, or maneuver to use elements such as at doors, fixtures, and telephones. The exception permits slopes not steeper than 1:48.

304.3 Size. Turning space shall comply with Subsection 304.3.1 or 304.3.2.

304.3.1 Circular space. The turning space shall be a space of 60 inches diameter minimum. The space shall be permitted to include knee and toe clearance complying with Section 306.

304.3.2 T-shaped space. The turning space shall be a T-shaped space within a 60 inch square minimum with arms and base 36 inches wide minimum. Each arm of the T shall be clear of obstructions 12 inches minimum in each direction and the base shall be clear of obstructions 24 inches minimum. The space shall be permitted to include knee and toe clearance complying with Section 306 only at the end of either the base or one arm.



**FIGURE 304.3.2
T-SHAPED TURNING SPACE**

304.4 Door swing. Doors shall be permitted to swing into turning spaces.

SECTION 305 CLEAR FLOOR OR GROUND SPACE

305.1 General. Clear floor or ground space shall comply with this Section.

305.2 Floor or Ground Surfaces. Floor or ground surfaces of a clear floor or ground space shall comply with Section 302. Changes in level are not permitted.

Exception: Slopes not steeper than 1:48 shall be permitted.

305.3 Size. The clear floor or ground space shall be 30 inches minimum by 48 inches minimum.

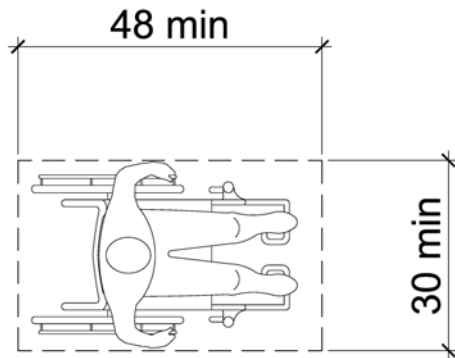


FIGURE 305.3
CLEAR FLOOR OR GROUND SPACE

305.4 Knee and toe clearance. Unless otherwise specified, clear floor or ground space shall be permitted to include knee and toe clearance complying with Section 306.

305.5 Position. Unless otherwise specified, clear floor or ground space shall be positioned for either forward or parallel approach to an element.

305.6 Approach. One full unobstructed side of the clear floor or ground space shall adjoin an accessible route or adjoin another clear floor or ground space.

305.7 Maneuvering clearance. Where a clear floor or ground space is located in an alcove or otherwise confined on all or part of three sides, additional maneuvering clearance shall be provided in accordance with Subsections 305.7.1 and 305.7.2.

305.7.1 Forward approach. Alcoves shall be 36 inches wide minimum where the depth exceeds 24 inches.

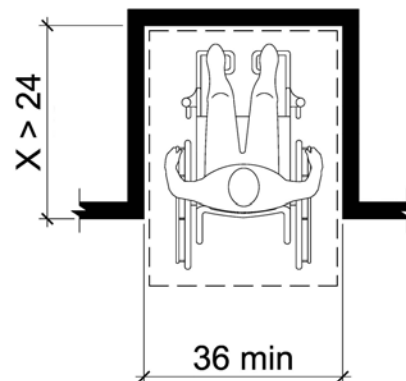


FIGURE 305.7.1
MANEUVERING CLEARANCE IN
AN ALCOVE, FORWARD APPROACH

305.7.2 Parallel approach. Alcoves shall be 60 inches wide minimum where the depth exceeds 15 inches.

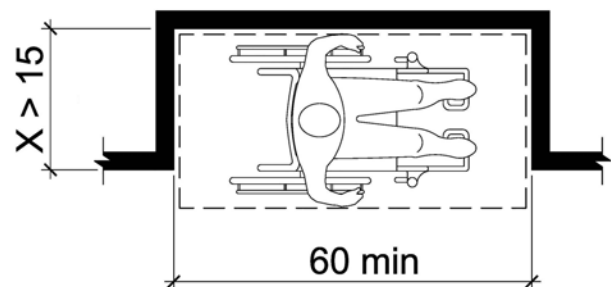


FIGURE 305.7.2
MANEUVERING CLEARANCE
IN AN ALCOVE, PARALLEL APPROACH

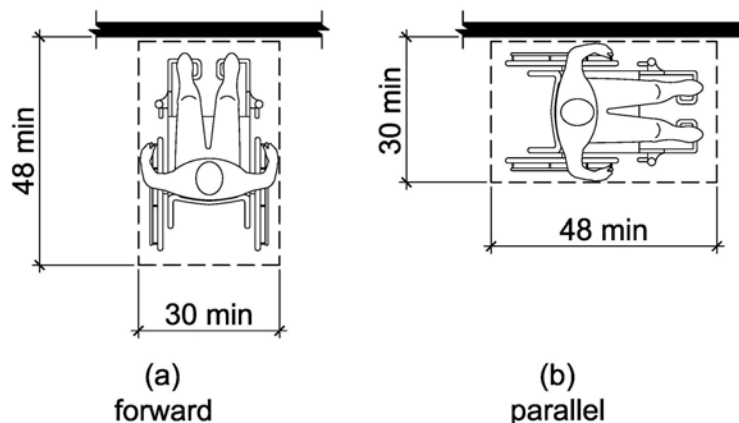


FIGURE 305.5
POSITION OF CLEAR FLOOR OR GROUND SPACE

SECTION 306 KNEE AND TOE CLEARANCE

306.1 General. Where space beneath an element is included as part of clear floor or ground space or turning space, the space shall comply with this Section. Additional space shall not be prohibited beneath an element but shall not be considered as part of the clear floor or ground space or turning space.

Advisory 306.1 General. Clearances are measured in relation to the usable clear floor space, not necessarily to the vertical support for an element. When determining clearance under an object for required turning or maneuvering space, care should be taken to ensure the space is clear of any obstructions.

306.2 Toe clearance.

306.2.1 General. Space under an element between the finish floor or ground and 9 inches above the finish floor or ground shall be considered toe clearance and shall comply with Subsection 306.2.

306.2.2 Maximum depth. Toe clearance shall extend 25 inches maximum under an element.

306.2.3 Minimum required depth. Where toe clearance is required at an element as part of a clear floor space, the toe clearance shall extend 17 inches minimum under the element.

306.2.4 Additional clearance. Space extending greater than 6 inches beyond the available knee clearance at 9 inches above the finish floor or ground shall not be considered toe clearance.

306.2.5 Width. Toe clearance shall be 30 inches wide minimum.

306.3 Knee clearance.

306.3.1 General. Space under an element between 9 inches and 27 inches above the finish floor or ground shall be considered knee clearance and shall comply with Subsection 306.3.

306.3.2 Maximum depth. Knee clearance shall extend 25 inches maximum under an element at 9 inches above the finish floor or ground.

306.3.3 Minimum required depth. Where knee clearance is required under an element as part of a clear floor space, the knee clearance shall be 11 inches deep minimum at 9 inches above the finish floor or ground, and 8 inches deep minimum at 27 inches above the finish floor or ground.

306.3.4 Clearance reduction. Between 9 inches and 27 inches above the finish floor or ground, the knee clearance shall be permitted to reduce at a rate of 1 inch in depth for each 6 inches in height.

306.3.5 Width. Knee clearance shall be 30 inches wide minimum.

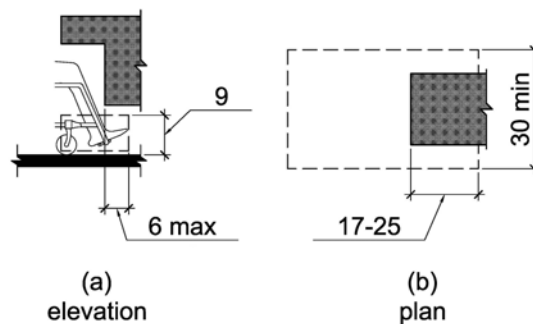


FIGURE 306.2
TOE CLEARANCE

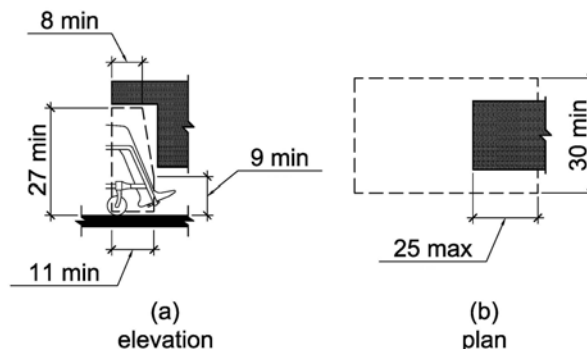


FIGURE 306.3
KNEE CLEARANCE

SECTION 307 PROTRUDING OBJECTS

307.1 General. Protruding objects shall comply with this Section.

307.2 Protrusion limits. Objects with leading edges more than 27 inches and not more than 80 inches above the finish floor or ground shall protrude 4 inches maximum horizontally into the circulation path.

Exception: Handrails shall be permitted to protrude $4\frac{1}{2}$ inches maximum.

Advisory 307.2 Protrusion limits. When a cane is used and the element is in the detectable range, it gives a person sufficient time to detect the element with the cane before there is body contact. Elements located on circulation paths, including operable elements, must comply with requirements for protruding objects. For example, awnings and their supporting structures cannot reduce the minimum required vertical clearance. Similarly, casement windows, when open, cannot encroach more than 4 inches into circulation paths above 27 inches.

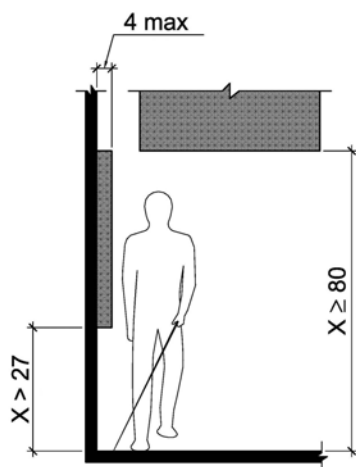


FIGURE 307.2
LIMITS OF PROTRUDING OBJECTS

307.3 Post-mounted objects. Free-standing objects mounted on posts or pylons shall overhang circulation paths 12 inches maximum when located 27 inches minimum and 80 inches maximum above the finish floor or ground. Where a sign or other obstruction is mounted between posts or pylons and the clear distance between the posts or pylons is greater than 12 inches, the lowest edge of such sign or obstruction shall be 27 inches maximum or 80 inches minimum above the finish floor or ground.

Exception: The sloping portions of handrails serving stairs and ramps shall not be required to comply with this Subsection.

307.4 Vertical clearance. Vertical clearance shall be 80 inches high minimum. Guardrails or other barriers shall be provided where the vertical clearance is less than 80 inches high. The leading edge of such guardrail or barrier shall be located 27 inches maximum above the finish floor or ground.

Exception: Door closers and door stops shall be permitted to be 78 inches minimum above the finish floor or ground.

307.5 Required clear width. Protruding objects shall not reduce the clear width required for accessible routes.

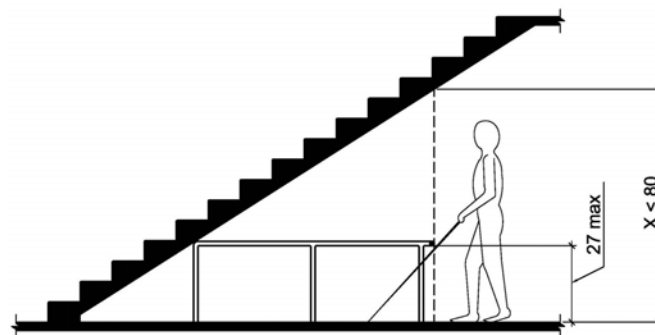


FIGURE 307.4
VERTICAL CLEARANCE

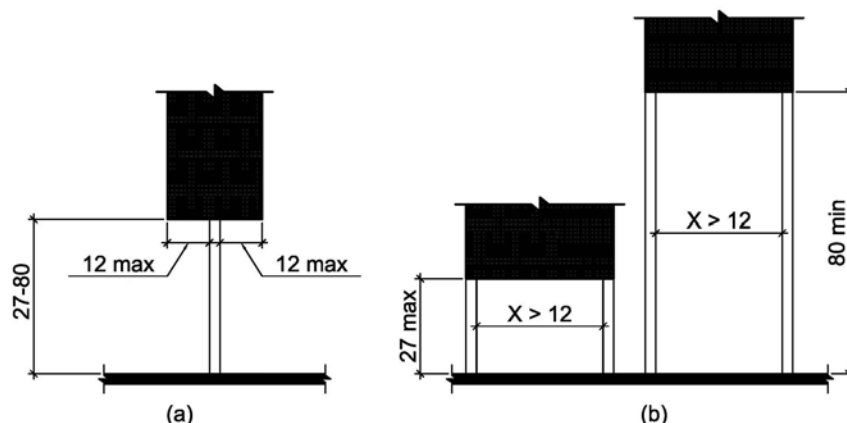


FIGURE 307.3
POST-MOUNTED PROTRUDING OBJECTS

SECTION 308 REACH RANGES

308.1 General. Reach ranges shall comply with this Section.

Advisory 308.1 General. The following table provides guidance on reach ranges for children according to age where building elements such as coat hooks, lockers, or operable parts are designed for use primarily by children. These dimensions apply to either forward or side reaches. Accessible elements and operable parts designed for adult use or children over age 12 can be located outside these ranges but must be within the adult reach ranges required by Section 308.

CHILDREN'S REACH RANGES			
Forward or Side Reach	Ages 3 and 4	Ages 5 through 8	Ages 9 through 12
High (maximum)	36 in	40 in	44 in
Low (minimum)	20 in	18 in	16 in

308.2 Forward reach.

308.2.1 Unobstructed. Where a forward reach is unobstructed, the high forward reach shall be 48 inches maximum and the low forward reach shall be 15 inches minimum above the finish floor or ground.

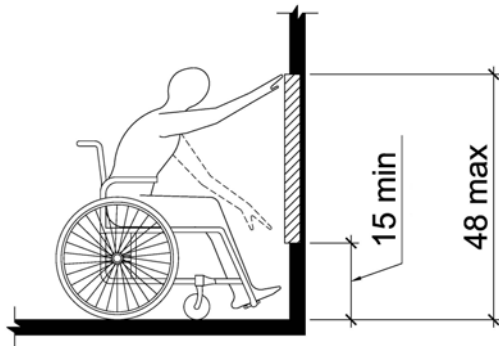


FIGURE 308.2.1
UNOBSTRUCTED FORWARD REACH

308.2.2 Obstructed high reach. Where a high forward reach is over an obstruction, the clear floor space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 inches maximum where the reach depth is 20 inches maximum. Where the reach depth exceeds 20 inches, the high forward reach shall be 44 inches maximum and the reach depth shall be 25 inches maximum.

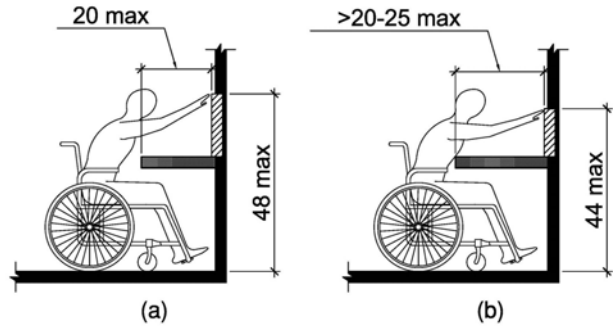


FIGURE 308.2.2
OBSTRUCTED HIGH FORWARD REACH

308.3 Side reach.

308.3.1 Unobstructed. Where a clear floor or ground space allows a parallel approach to an element and the side reach is unobstructed, the high side reach shall be 48 inches maximum and the low side reach shall be 15 inches minimum above the finish floor or ground.

Exceptions:

1. An obstruction shall be permitted between the clear floor or ground space and the element where the depth of the obstruction is 10 inches maximum.
2. Operable parts of fuel dispensers shall be permitted to be 54 inches maximum measured from the surface of the vehicular way where fuel dispensers are installed on existing curbs.

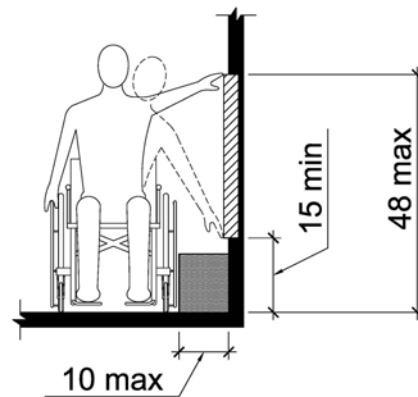


FIGURE 308.3.1
UNOBSTRUCTED SIDE REACH

308.3.2 Obstructed high reach. Where a clear floor or ground space allows a parallel approach to an element and the high side reach is over an obstruction, the height of the obstruction shall be 34 inches maximum and the depth of the obstruction shall be 24 inches maximum. The high side reach shall be 48 inches maximum for a reach depth of 10 inches maximum. Where the reach depth exceeds 10

inches, the high side reach shall be 46 inches maximum for a reach depth of 24 inches maximum.

Exceptions:

1. The top of washing machines and clothes dryers shall be permitted to be 36 inches maximum above the finish floor.
2. Operable parts of fuel dispensers shall be permitted to be 54 inches maximum measured from the surface of the vehicular way where fuel dispensers are installed on existing curbs.

SECTION 309 OPERABLE PARTS

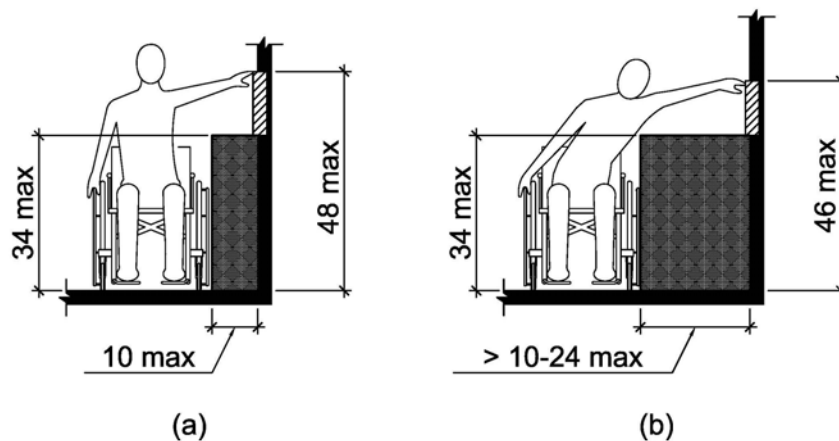
309.1 General. Operable parts shall comply with this Section.

309.2 Clear floor space. A clear floor or ground space complying with Section 305 shall be provided.

309.3 Height. Operable parts shall be placed within one or more of the reach ranges specified in Section 308.

309.4 Operation. Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds maximum.

Exception: Gas pump nozzles shall not be required to provide operable parts that have an activating force of 5 pounds maximum.



**FIGURE 308.3.2
OBSTRUCTED HIGH SIDE REACH**

CHAPTER 4

ACCESSIBLE ROUTES

SECTION 401 GENERAL

401.1 Scope. The provisions of Chapter 4 shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

SECTION 402 ACCESSIBLE ROUTES

402.1 General. Accessible routes shall comply with this Section.

402.2 Components. Accessible routes shall consist of one or more of the following components: walking surfaces with a running slope not steeper than 1:20, doorways, ramps, curb ramps excluding the flared sides, elevators, and platform lifts. All components of an accessible route shall comply with the applicable requirements of Subsection 208.3.1 and Chapter 4.

Advisory 402.2 Components. Walking surfaces must have running slopes not steeper than 1:20 (see Subsection 403.3). Other components of accessible routes, such as ramps (see Section 405) and curb ramps (see Section 406), are permitted to be more steeply sloped.

Florida requirements of Section 553.5041, F.S., incorporated in Subsection 208.3.1 for accessible routes to parking that modify requirements of Chapter 4 must be complied with. Pursuant to Section 553.512, F.S., Florida requirements, except Section 553.5041(5)(a) width of accessible route to parking and Section 553.041(c)1 parking space and access aisle width, may be waived down to the requirements of the *ADA Standards for Accessible Design*.

SECTION 403 WALKING SURFACES

403.1 General. Walking surfaces that are a part of an accessible route shall comply with this Section.

403.2 Floor or ground surface. Floor or ground surfaces shall comply with Section 302.

403.3 Slope. The running slope of walking surfaces shall not be steeper than 1:20. The cross slope of walking surfaces shall not be steeper than 1:48.

403.4 Changes in level. Changes in level shall comply with Section 303.

403.5 Clearances. Walking surfaces shall provide clearances complying with this Subsection.

Exception: Within employee work areas, clearances on common use circulation paths shall be permitted to be decreased by work area equipment provided that the decrease is essential to the function of the work being performed.

403.5.1 Clear width. Except as provided in Subsections 403.5.2 and 403.5.3, the clear width of walking surfaces shall be 36 inches minimum.

Exception: The clear width shall be permitted to be reduced to 32 inches minimum for a length of 24 inches maximum provided that reduced width segments are separated by segments that are 48 inches long minimum and 36 inches wide minimum.

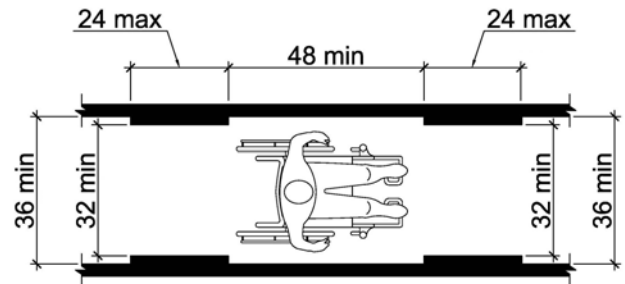


FIGURE 403.5.1
CLEAR WIDTH OF AN ACCESSIBLE ROUTE

403.5.2 Clear width at turn. Where the accessible route makes a 180 degree turn around an element which is less than 48 inches wide, clear width shall be 42 inches minimum approaching the turn, 48 inches minimum at the turn and 42 inches minimum leaving the turn.

Exception: Where the clear width at the turn is 60 inches minimum compliance with this Subsection shall not be required.

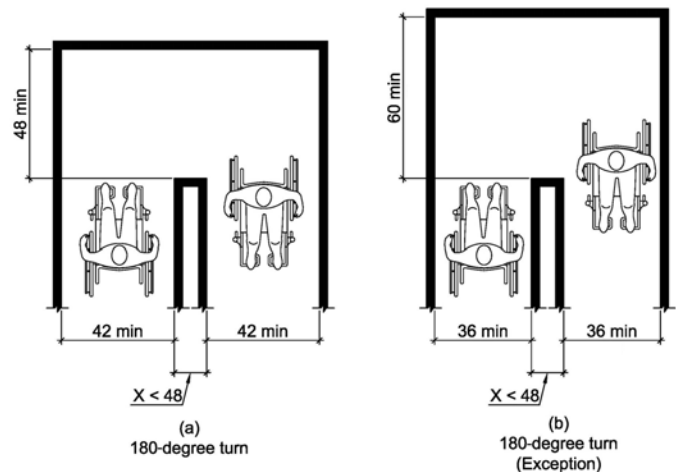


FIGURE 403.5.2
CLEAR WIDTH AT TURN

403.5.3 Passing spaces. An accessible route with a clear width less than 60 inches shall provide passing spaces at intervals of 200 feet maximum. Passing spaces shall be either: a space 60 inches minimum by 60 inches minimum; or, an intersection of two walking surfaces providing a T-shaped space complying with 304.3.2 where the base and arms of the T-shaped space extend 48 inches minimum beyond the intersection.

403.6 Handrails. Where handrails are provided along walking surfaces with running slopes not steeper than 1:20 they shall comply with Section 505.

Advisory 403.6 Handrails. Handrails provided in elevator cabs and platform lifts are not required to comply with the requirements for handrails on walking surfaces.

SECTION 404 DOORS, DOORWAYS, AND GATES

404.1 General. Doors, doorways, and gates that are part of an accessible route shall comply with this Section.

Exception: Doors, doorways, and gates designed to be operated only by security personnel shall not be required to comply with Subsections 404.2.7, 404.2.8, 404.2.9, 404.3.2 and 404.3.4 through 404.3.7.

Advisory 404.1 General exception. Security personnel must have sole control of doors that are eligible for the Exception to this Subsection. It would not be acceptable for security personnel to operate the doors for people with disabilities while allowing others to have independent access.

404.2 Manual doors, doorways, and manual gates. Manual doors and doorways and manual gates intended for user passage shall comply with this Subsection.

404.2.1 Revolving doors, gates, and turnstiles. Revolving doors, revolving gates, and turnstiles shall not be part of an accessible route.

404.2.2 Double-leaf doors and gates. At least one of the active leaves of doorways with two leaves shall comply with Subsections 404.2.3 and 404.2.4.

404.2.3 Clear width. Door openings shall provide a clear width of 32 inches minimum. Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees. Openings more than 24 inches deep shall provide a clear opening of 36 inches minimum. There shall be no projections into the required clear opening width lower than 34 inches above the finish floor or ground. Projections into the clear opening width between 34 inches and 80 inches above the finish floor or ground shall not exceed 4 inches.

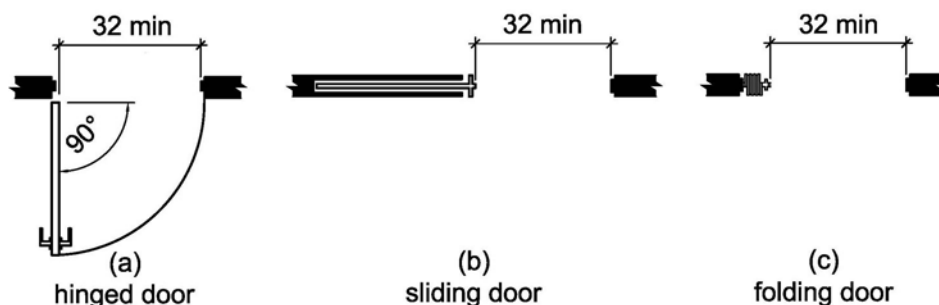
Exceptions:

1. In alterations, a projection of $\frac{3}{8}$ inch maximum into the required clear width shall be permitted for the latch side stop.
2. Door closers and door stops shall be permitted to be 78 inches minimum above the finish floor or ground.

404.2.4 Maneuvering clearances. Minimum maneuvering clearances at doors and gates shall comply with this Subsection. Maneuvering clearances shall extend the full width of the doorway and the required latch side or hinge side clearance.

Exception: Entry doors to hospital patient rooms shall not be required to provide the clearance beyond the latch side of the door.

404.2.4.1 Swinging doors and gates. Swinging doors and gates shall have maneuvering clearances complying with Table 404.2.4.1.



**FIGURE 404.2.3
CLEAR WIDTH OF DOORWAYS**

TABLE 404.2.4.1
MANEUVERING CLEARANCE AT MANUAL SWINGING DOORS AND GATES

TYPE OF USE		MINIMUM MANEUVERING CLEARANCE	
Approach Direction	Door or Gate Side	Perpendicular to Doorway	Parallel to Doorway (beyond latch side unless noted)
From front	Pull	60 inches	18 inches
From front	Push	48 inches	0 inches ¹
From hinge side	Pull	60 inches	36 inches
From hinge side	Pull	54 inches	42 inches
From hinge side	Push	42 inches ²	22 inches ³
From latch side	Pull	48 inches ⁴	24 inches
From latch side	Push	42 inches ⁴	24 inches

1. Add 12 inches if closer and latch are provided.
2. Add 6 inches if closer and latch are provided.
3. Beyond hinge side.
4. Add 6 inches if closer is provided.

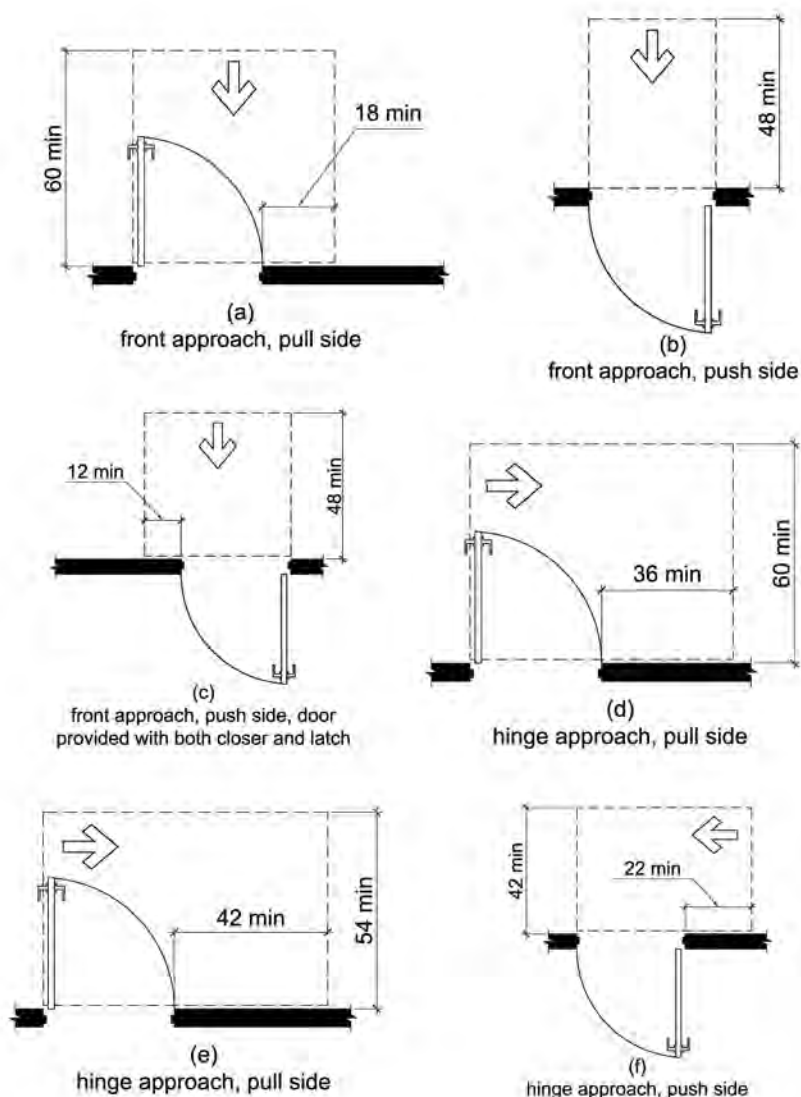


FIGURE 404.2.4.1
MANEUVERING CLEARANCES AT MANUAL SWINGING DOORS AND GATES

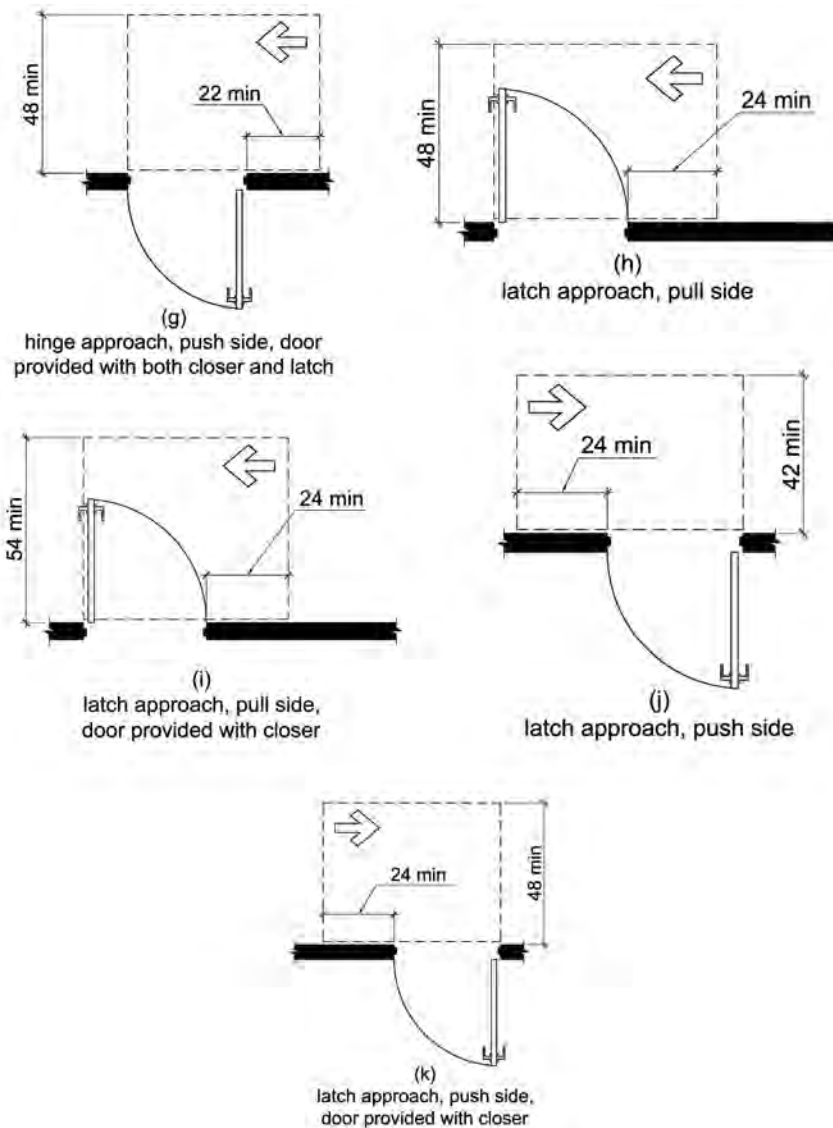


FIGURE 404.2.4.1—CONTINUED
MANEUVERING CLEARANCES AT MANUAL SWINGING DOORS AND GATES

404.2.4.2 Doorways without doors or gates, sliding doors, and folding doors. Doorways less than 36 inches wide without doors or gates, sliding doors, or folding doors shall have maneuvering clearances complying with Table 404.2.4.2.

**TABLE 404.2.4.2
MANEUVERING CLEARANCES AT DOORWAYS
WITHOUT DOORS OR GATES, MANUAL SLIDING
DOORS, AND MANUAL FOLDING DOORS**

Approach Direction	MINIMUM MANEUVERING CLEARANCE	
	Perpendicular to Doorway	Parallel to Doorway (beyond stop/latch side unless noted)
From Front	48 inches	0 inches
From side ¹	42 inches	0 inches
From pocket/hinge side	42 inches	22 inches ²
From stop/latch side	42 inches	24 inches

1. Doorway with no door only.

2. Beyond pocket/hinge side.

404.2.4.3 Recessed doors and gates. Maneuvering clearances for forward approach shall be provided when any obstruction within 18 inches of the latch side of a doorway projects more than 8 inches beyond the face of the door, measured perpendicular to the face of the door or gate

Advisory 404.2.4.3 Recessed doors and gates. A door can be recessed due to wall thickness or because of the placement of casework and other fixed elements adjacent to the doorway. This provision must be applied wherever doors are recessed.

404.2.4.4 Floor or ground surface. Floor or ground surface within required maneuvering clearances shall comply with Section 302. Changes in level are not permitted.

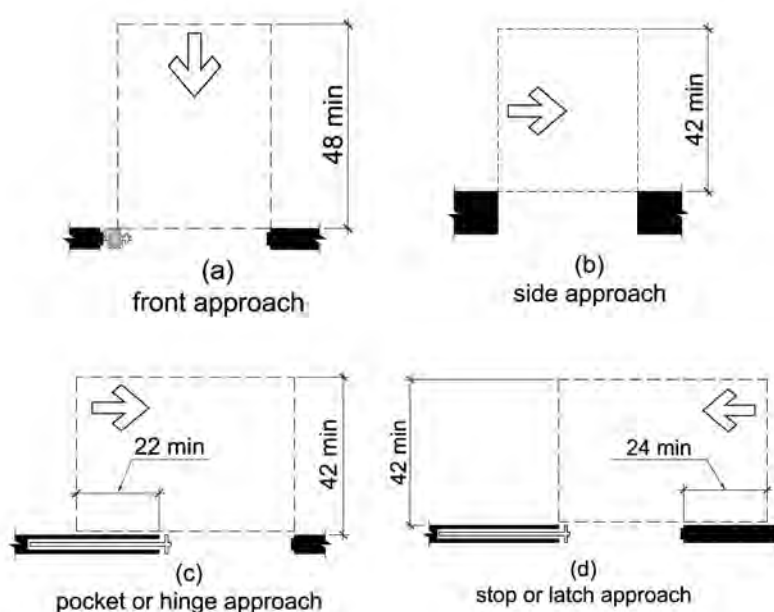
Exceptions:

1. Slopes not steeper than 1:48 shall be permitted.
2. Changes in level at thresholds complying with Subsection 404.2.5 shall be permitted.

404.2.5 Thresholds. Thresholds, if provided at doorways, shall be $\frac{1}{2}$ inch high maximum. Raised thresholds and changes in level at doorways shall comply with Sections 302 and 303.

Exception: Existing or altered thresholds $\frac{3}{4}$ inch high maximum that have a beveled edge on each side with a slope not steeper than 1:2 shall not be required to comply with Subsection 404.2.5.

404.2.6 Doors in series and gates in series. The distance between two hinged or pivoted doors in series and gates in series shall be 48 inches minimum plus the width of doors or gates swinging into the space.



**FIGURE 404.2.4.2
MANEUVERING CLEARANCES AT DOORWAYS WITHOUT DOORS, SLIDING DOORS, GATES, AND FOLDING DOORS**

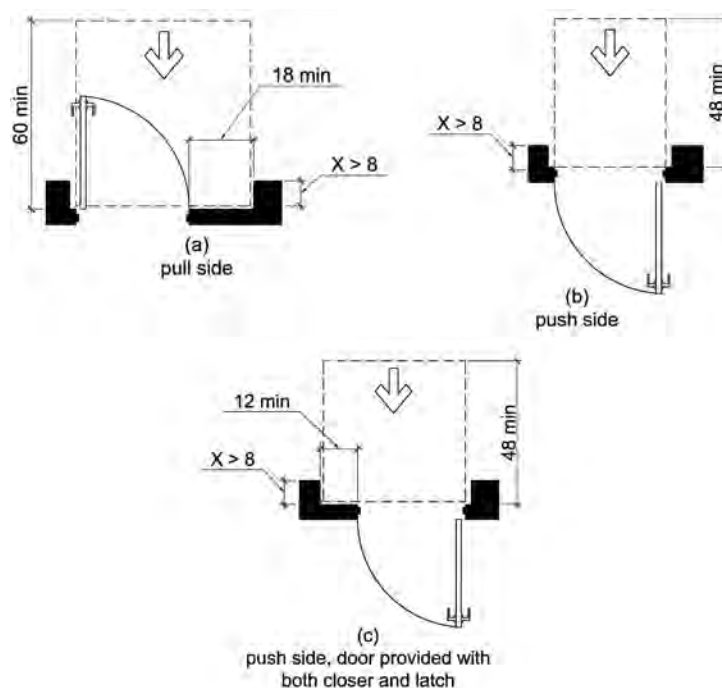


FIGURE 404.2.4.3
MANEUVERING CLEARANCES AT RECESSED DOORS AND GATES

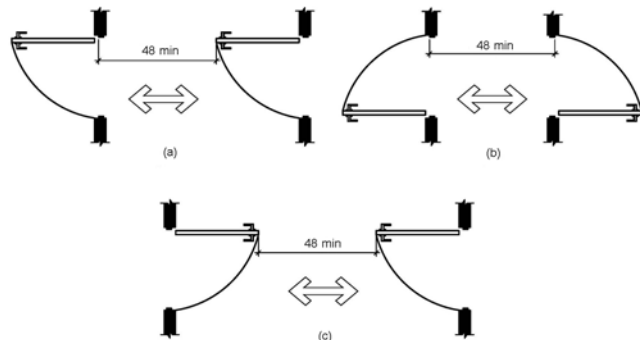


FIGURE 404.2.6
DOORS IN SERIES AND GATES IN SERIES

404.2.7 Door and gate hardware. Handles, pulls, latches, locks, and other operable parts on doors and gates shall comply with Subsection 309.4. Operable parts of such hardware shall be 34 inches minimum and 48 inches maximum above the finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.

Exceptions:

- Existing locks shall be permitted in any location at existing glazed doors without stiles, existing overhead rolling doors or grilles, and similar existing doors or grilles that are designed with locks that are activated only at the top or bottom rail.

- Access gates in barrier walls and fences protecting pools, spas, and hot tubs shall be permitted to have operable parts of the release of latch on self-latching devices at 54 inches maximum above the finish floor or ground provided the self-latching devices are not also self-locking devices and operated by means of a key, electronic opener, or integral combination lock.

Advisory 404.2.7 Door and gate hardware. Door hardware that can be operated with a closed fist or a loose grip accommodates the greatest range of users. Hardware that requires simultaneous hand and finger movements require greater dexterity and coordination, and is not recommended.

404.2.8 Closing speed. Door and gate closing speed shall comply with this Subsection.

404.2.8.1 Door closers and gate closers. Door closers and gate closers shall be adjusted so that from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.

404.2.8.2 Spring hinges. Door and gate spring hinges shall be adjusted so that from the open position of 70 degrees, the door or gate shall move to the closed position in 1.5 seconds minimum.

404.2.9 Door and gate opening force. Fire doors shall have a minimum opening force allowable by the appropriate administrative authority. The force for pushing or pull-

ing open a door or gate other than fire doors shall be as follows:

1. Interior hinged doors and gates: 5 pounds maximum.
2. Sliding or folding doors: 5 pounds maximum.
3. Exterior hinged doors shall be designed so that such doors can be pushed or pulled open with a force not exceeding 8.5 pounds.

These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door or gate in a closed position.

Advisory 404.2.9 Door and gate opening force. The maximum force pertains to the continuous application of force necessary to fully open a door, not the initial force needed to overcome the inertia of the door. It does not apply to the force required to retract bolts or to disengage other devices used to keep the door in a closed position.

Florida law, Section 553.504(3), F.S., establishes requirements for exterior door opening force.

404.2.10 Door and gate surfaces. Swinging door and gate surfaces within 10 inches of the finish floor or ground measured vertically shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within $\frac{1}{16}$ inch of the same plane as the other. Cavities created by added kick plates shall be capped.

Exceptions:

1. Sliding doors shall not be required to comply with this Subsection.
2. Tempered glass doors without stiles and having a bottom rail or shoe with the top leading edge tapered at 60 degrees minimum from the horizontal shall not be required to meet the 10 inch bottom smooth surface height requirement.
3. Doors and gates that do not extend to within 10 inches of the finish floor or ground shall not be required to comply with this Subsection.
4. Existing doors and gates without smooth surfaces within 10 inches of the finish floor or ground shall not be required to provide smooth surfaces complying with this Subsection provided that if added kick plates are installed, cavities created by such kick plates are capped.

404.2.11 Vision lights. Doors, gates, and side lights adjacent to doors or gates, containing one or more glazing panels that permit viewing through the panels shall have the bottom of at least one glazed panel located 43 inches maximum above the finish floor.

Exception: Vision lights with the lowest part more than 66 inches from the finish floor or ground shall not be required to comply with this Subsection.

404.3 Automatic and power-assisted doors and gates. Automatic doors and automatic gates shall comply with this Subsection. Full-powered automatic doors shall comply with

ANSI/BHMA A156.10 (incorporated by reference, see “Referenced Standards” in Chapter 1). Low-energy and power-assisted doors shall comply with ANSI/BHMA A156.19 (1997 or 2002 edition) (incorporated by reference, see “Referenced Standards” in Chapter 1). Such doors shall not open to back check faster than 3 seconds and shall require no more than 15 pounds per foot to stop door movement. If a power-assisted door is used, its door-opening force shall comply with Subsection 404.2.9 and its closing shall conform to the requirements in ANSI/BHMA A156.19.

404.3.1 Clear width. Doorways shall provide a clear opening of 32 inches minimum in power-on and power-off mode. The minimum clear width for automatic door systems in a doorway shall be based on the clear opening provided by all leaves in the open position.

404.3.2 Maneuvering clearance. Clearances at power-assisted doors and gates shall comply with Subsection 404.2.4. Clearances at automatic doors and gates without standby power and serving an accessible means of egress shall comply with Subsection 404.2.4.

Exception: Where automatic doors and gates remain open in the power-off condition, compliance with Subsection 404.2.4 shall not be required.

404.3.3 Thresholds. Thresholds and changes in level at doorways shall comply with Subsection 404.2.5.

404.3.4 Doors in series and gates in series. Doors in series and gates in series shall comply with Subsection 404.2.6.

404.3.5 Controls. Manually operated controls shall comply with Section 309. The clear floor space adjacent to the control shall be located beyond the arc of the door swing.

404.3.6 Break out opening. Where doors and gates without standby power are a part of a means of egress, the clear break out opening at swinging or sliding doors and gates shall be 32 inches minimum when operated in emergency mode.

Exception: Where manual swinging doors and gates comply with Subsection 404.2 and serve the same means of egress compliance with this Subsection shall not be required.

404.3.7 Revolving doors, revolving gates, and turnstiles. Revolving doors, revolving gates, and turnstiles shall not be part of an accessible route.

SECTION 405 RAMPS

405.1 General. Ramps on accessible routes shall comply with this Section.

Exception: In assembly areas, aisle ramps adjacent to seating and not serving elements required to be on an accessible route shall not be required to comply with this Section.

405.2 Slope. Ramp runs shall have a running slope not steeper than 1:12.

Exception: In existing sites, buildings, and facilities, ramps shall be permitted to have running slopes steeper

ACCESSIBLE ROUTES

than 1:12 complying with Table 405.2 where such slopes are necessary due to space limitations.

TABLE 405.2
MAXIMUM RAMP SLOPE AND RISE
FOR EXISTING SITES, BUILDINGS, AND FACILITIES

SLOPE ¹	MAXIMUM RISE
Steeper than 1:10 but not steeper than 1:8	3 inches
Steeper than 1:12 but not steeper than 1:10	6 inches

1. A slope steeper than 1:8 is prohibited.

Advisory 405.2 Slope. To accommodate the widest range of users, provide ramps with the least possible running slope and, wherever possible, accompany ramps with stairs for use by those individuals for whom distance presents a greater barrier than steps, e.g., people with heart disease or limited stamina.

405.3 Cross slope. Cross slope of ramp runs shall not be steeper than 1:48.

Advisory 405.3 Cross slope. Cross slope is the slope of the surface perpendicular to the direction of travel. Cross slope is measured the same way as slope is measured (i.e., the rise over the run).

405.4 Floor or ground surfaces. Floor or ground surfaces of ramp runs shall comply with Section 302. Changes in level other than the running slope and cross slope are not permitted on ramp runs.

405.5 Clear width. The clear width of a ramp run and, where handrails are provided, the clear width between handrails shall be 36 inches minimum.

Exception: Within employee work areas, the required clear width of ramps that are a part of common use circulation paths shall be permitted to be decreased by work area equipment provided that the decrease is essential to the function of the work being performed.

405.6 Rise. The rise for any ramp run shall be 30 inches maximum.

405.7 Landings. Ramps shall have landings at the top and the bottom of each ramp run. Landings shall comply with this Subsection.

Advisory 405.7 Landings. Ramps that do not have level landings at changes in direction can create a compound slope that will not meet the requirements of this Code. Circular or curved ramps continually change direction. Curvilinear ramps with small radii also can create compound cross slopes and cannot, by their nature, meet the requirements for accessible routes. A level landing is needed at the accessible door to permit maneuvering and simultaneously door operation.

405.7.1 Slope. Landings shall comply with Section 302. Changes in level are not permitted.

Exception: Slopes not steeper than 1:48 shall be permitted.

405.7.2 Width. The landing clear width shall be at least as wide as the widest ramp run leading to the landing.

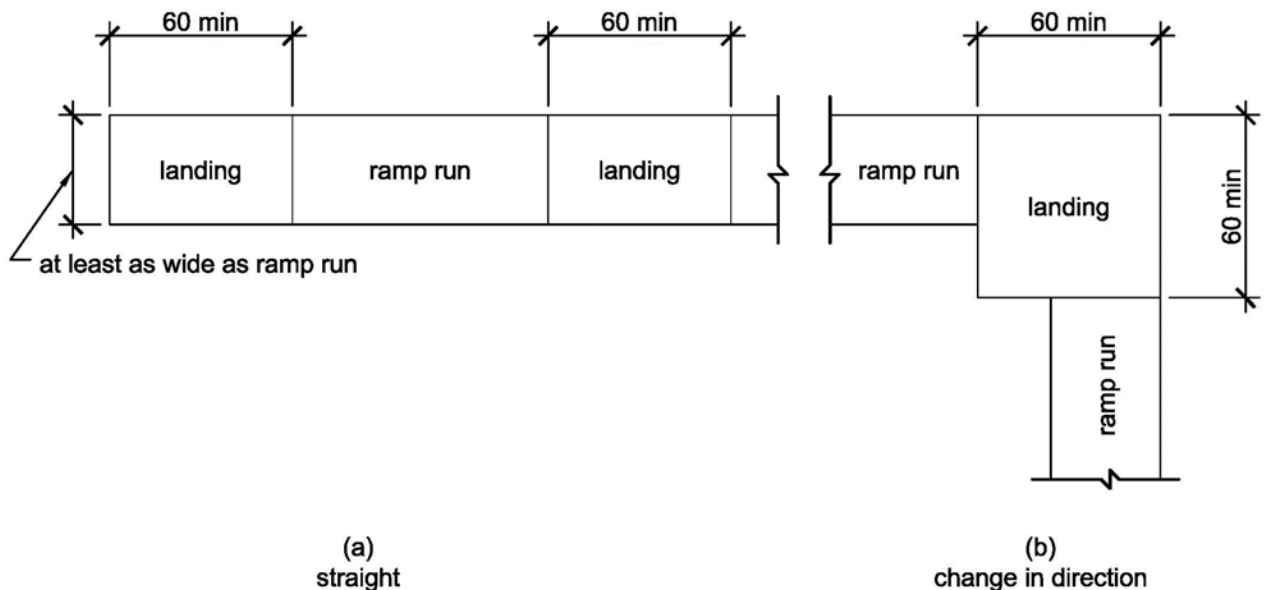


FIGURE 405.7
RAMP LANDINGS

405.7.3 Length. The landing clear length shall be 60 inches long minimum.

405.7.4 Change in direction. Ramps that change direction between runs at landings shall have a clear landing 60 inches minimum by 60 inches minimum.

405.7.5 Doorways. Where doorways are located adjacent to a ramp landing, maneuvering clearances required by Subsections 404.2.4 and 404.3.2 shall be permitted to overlap the required landing area.

405.8 Handrails. Ramp runs with a rise greater than 6 inches shall have handrails complying with Section 505.

Exception: Within employee work areas, handrails shall not be required where ramps that are part of common use circulation paths are designed to permit the installation of handrails complying with Section 505. Ramps not subject to the exception to Subsection 405.5 shall be designed to maintain a 36 inch minimum clear width when handrails are installed.

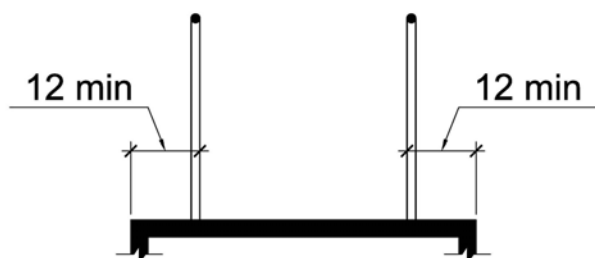
405.9 Edge protection. Edge protection complying with Subsection 405.9.1 or 405.9.2 shall be provided on each side of ramp runs and at each side of ramp landings.

Exceptions:

1. Edge protection shall not be required on ramps that are not required to have handrails and have sides complying with Subsection 406.3.
2. Edge protection shall not be required on the sides of ramp landings serving an adjoining ramp run or stairway.
3. Edge protection shall not be required on the sides of ramp landings having a vertical drop-off of $\frac{1}{2}$ inch maximum within 10 inches horizontally of the minimum landing area specified in Subsection 405.7.

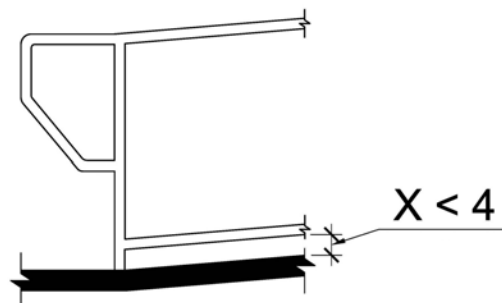
405.9.1 Extended floor or ground surface. The floor or ground surface of the ramp run or landing shall extend 12 inches minimum beyond the inside face of a handrail complying with Section 505.

Advisory 405.9.1 Extended floor or ground surface. The extended surface prevents wheelchair casters and crutch tips from slipping off the ramp surface.



**FIGURE 405.9.1
EXTENDED FLOOR OR GROUND
SURFACE EDGE PROTECTION**

405.9.2 Curb or barrier. A curb or barrier shall be provided that prevents the passage of a 4 inch diameter sphere, where any portion of the sphere is within 4 inches of the finish floor or ground surface.



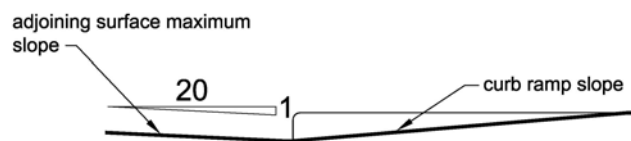
**FIGURE 405.9.2
CURB OR BARRIER EDGE PROTECTION**

405.10 Wet conditions. Landings subject to wet conditions shall be designed to prevent the accumulation of water.

SECTION 406 CURB RAMPS

406.1 General. Curb ramps on accessible routes shall comply with this Section and Subsections 405.2 through 405.5, and 405.10.

406.2 Counter slope. Counter slopes of adjoining gutters and road surfaces immediately adjacent to the curb ramp shall not be steeper than 1:20. The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level.



**FIGURE 406.2
COUNTER SLOPE OF SURFACES ADJACENT TO CURB RAMP**

406.3 Sides of curb ramps. Where provided, curb ramp flares shall not be steeper than 1:10.

406.4 Landings. Landings shall be provided at the tops of curb ramps. The landing clear length shall be 36 inches minimum. The landing clear width shall be at least as wide as the curb ramp, excluding flared sides, leading to the landing.

Exception: In alterations, where there is no landing at the top of curb ramps, curb ramp flares shall be provided and shall not be steeper than 1:12.

ACCESSIBLE ROUTES

406.5 Location. Curb ramps and the flared sides of curb ramps shall be located so that they do not project into vehicular traffic lanes, parking spaces, or parking access aisles. Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides.

406.6 Diagonal curb ramps. Diagonal or corner type curb ramps with returned curbs or other well-defined edges shall have the edges parallel to the direction of pedestrian flow. The bottom of diagonal curb ramps shall have a clear space 48 inches minimum outside active traffic lanes of the roadway. Diagonal curb ramps provided at marked crossings shall provide the 48 inches minimum clear space within the markings. Diagonal curb ramps with flared sides shall have a segment of curb 24 inches long minimum located on each side of the curb ramp and within the marked crossing.

406.7 Islands. Raised islands in crossings shall be cut through level with the street or have curb ramps at both sides. Each curb ramp shall have a level area 48 inches long minimum by 36 inches wide minimum at the top of the curb ramp in the part of the island intersected by the crossings. Each 48 inch minimum by 36 inch minimum area shall be oriented so that the 48 inch minimum length is in the direction of the running slope of the curb ramp it serves. The 48 inch minimum by 36 inch minimum areas and the accessible route shall be permitted to overlap.

406.8 Detectable warnings. Curb ramps subject to Department of Transportation regulation 49 CFR 37.21 shall have a detectable warning complying with Section 705. The detectable warning shall extend the full width of the curb ramp (exclusive of flared sides) and shall extend either the full depth of the curb ramp or 24 inches deep minimum measured from the back of the curb on the ramp surface.

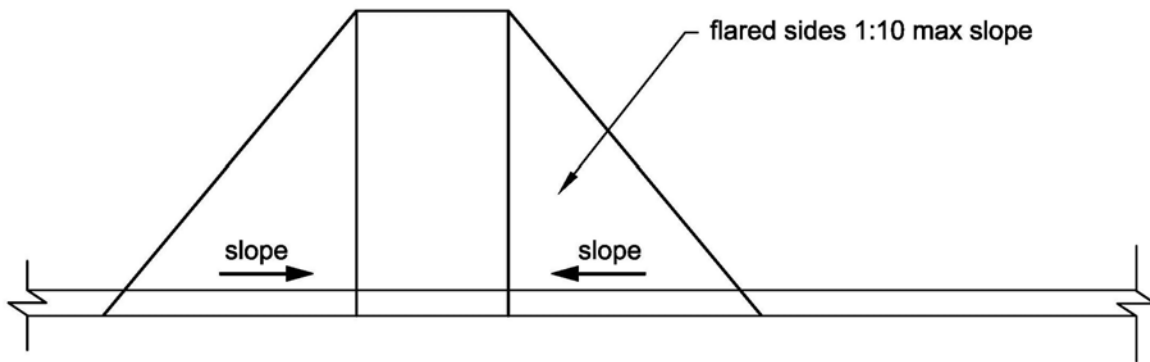


FIGURE 406.3
SIDES OF CURB RAMPS

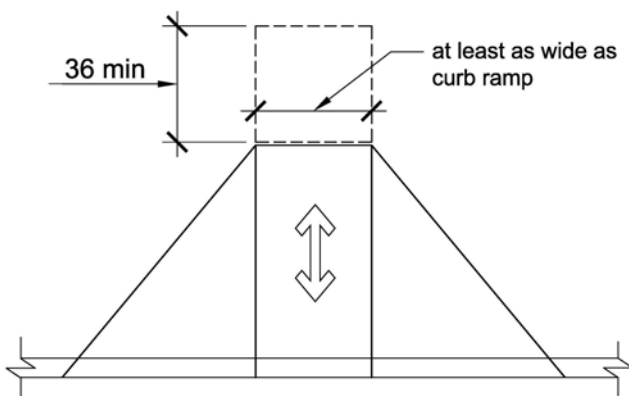


FIGURE 406.4
LANDINGS AT THE TOP OF CURB RAMPS

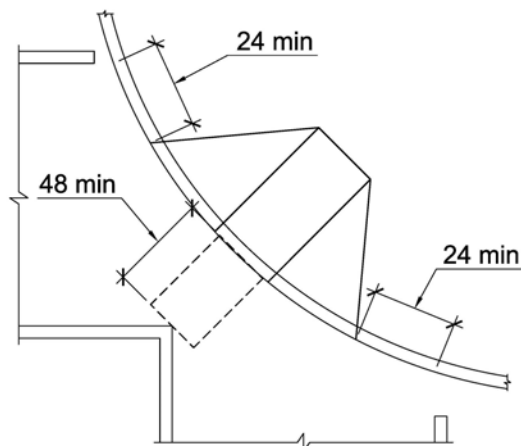


FIGURE 406.6
DIAGONAL OR CORNER TYPE CURB RAMPS

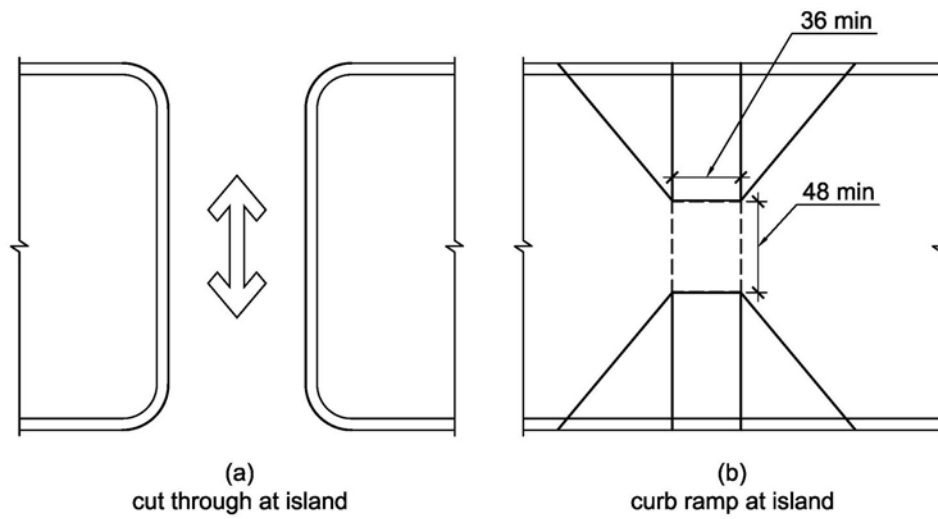


FIGURE 406.7
ISLANDS IN CROSSINGS

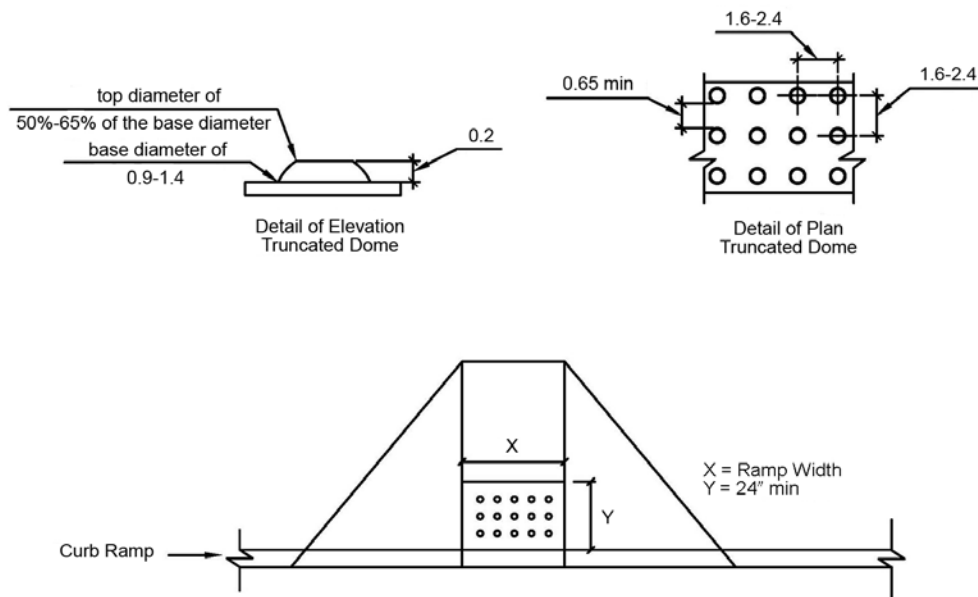


FIGURE 406.8
DETECTABLE WARNINGS AT CURB RAMPS SUBJECT TO DOT REGULATION 49 CFR, PART 37.21

SECTION 407 ELEVATORS

407.1 General. Elevators shall comply with this Section and with ASME A17.1 (incorporated by reference, see “Referenced Standards” in Chapter 1). They shall be passenger elevators as classified by ASME A17.1. Elevator operation shall be automatic.

Advisory 407.1 General. The ADA and other Federal civil rights laws require that accessible features be maintained in working order so that they are accessible to and usable by those people they are intended to benefit. Building owners should note that the ASME *Safety Code for Elevators and Escalators* requires routine maintenance and inspections. Isolated or temporary interruptions in service due to maintenance or repairs may be unavoidable; however, failure to take prompt action to effect repairs could constitute a violation of Federal laws and these requirements.

407.2 Elevator landing requirements. Elevator landings shall comply with this Subsection.

407.2.1 Call controls. Where elevator call buttons or keypads are provided, they shall comply with this Subsection and Subsection 309.4. Call buttons shall be raised or flush.

Exception: Existing elevators shall be permitted to have recessed call buttons.

407.2.1.1 Height. call buttons and keypads shall be located within one of the reach ranges specified in Section 308, measured to the centerline of the highest operable part.

Exception: Existing call buttons and existing keypads shall be permitted to be located at 54 inches maximum above the finish floor, measured to the centerline of the highest operable part.

407.2.1.2 Size. Call buttons shall be $\frac{3}{4}$ inch minimum in the smallest dimension.

Exception: Existing elevator call buttons shall not be required to comply with this Subsection.

407.2.1.3 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided at call controls.

Advisory 407.2.1.3 Clear floor or ground space. The clear floor or ground space required at elevator call buttons must remain free of obstructions including ashtrays, plants, and other decorative elements that prevent wheelchair users and others from reaching the call buttons. The height of the clear floor or ground space is considered to be a volume from the floor to 80 inches above the floor. Recessed ashtrays should not be placed near elevator call buttons so that persons who are blind or visually impaired do not inadvertently contact them or their contents as they reach for the call buttons.

407.2.1.4 Location. The call button that designates the up direction shall be located above the call button that designates the down direction.

Exception: Destination-oriented elevators shall not be required to comply with this Subsection.

Advisory 407.2.1.4 Location exception. A destination-oriented elevator system provides lobby controls enabling passengers to select floor stops, lobby indicators designating which elevator to use, and a car indicator designating the floors at which the car will stop. Responding cars are programmed for maximum efficiency by reducing the number of stops any passenger experiences.

407.2.1.5 Signals. Call buttons shall have visible signals to indicate when each call is registered and when each call is answered.

Exceptions:

1. Destination-oriented elevators shall not be required to comply with this Subsection provided that visible and audible signals complying with Subsection 407.2.2 indicating which elevator car to enter are provided.
2. Existing elevators shall not be required to comply with this Subsection.

407.2.1.6 Keypads. Where keypads are provided, keypads shall be in a standard telephone keypad arrangement and shall comply with Subsection 407.4.7.2.

407.2.2 Hall signals. Hall signals, including in-car signals, shall comply with this Subsection.

407.2.2.1 Visible and audible signals. A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call and the car’s direction of travel. Where in-car signals are provided, they shall be visible from the floor area adjacent to the hall call buttons.

Exceptions:

1. Visible and audible signals shall not be required at each destination-oriented elevator where a visible and audible signal complying with Subsection 407.2.2 is provided indicating the elevator car designation information.
2. In existing elevators, a signal indicating the direction of car travel shall not be required.

407.2.2.2 Visible signals. Visible signal fixtures shall be centered at 72 inches minimum above the finish floor or ground. The visible signal elements shall be $2\frac{1}{2}$ inches minimum measured along the vertical centerline of the element. Signals shall be visible from the floor area adjacent to the hall call button.

Exceptions:

1. Destination-oriented elevators shall be permitted to have signals visible from the floor area adjacent to the hoistway entrance.
2. Existing elevators shall not be required to comply with this Subsection.

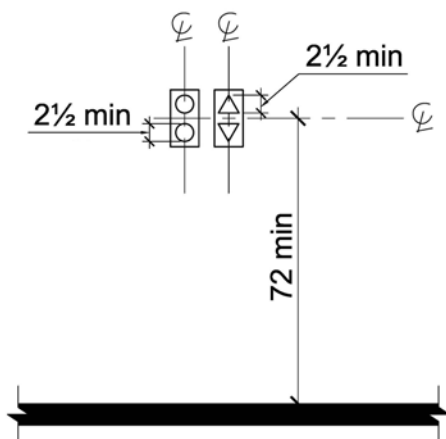


FIGURE 407.2.2.2
VISIBLE HALL SIGNALS

407.2.2.3 Audible signals. Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that indicate the direction of elevator car travel. Audible signals shall have a frequency of 1,500 Hz maximum. Verbal annunciators shall have a frequency of 300 Hz minimum and 3,000 Hz maximum. The audible signal and verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the hall call button.

Exceptions:

1. Destination-oriented elevators shall not be required to comply with this Subsection provided that the audible tone and verbal announcement is the same as those given at the call button or call button keypad.
2. Existing elevators shall not be required to comply with the requirements for frequency and dB range of audible signals.

407.2.2.4 Differentiation. Each destination-oriented elevator in a bank of elevators shall have audible and visible means for differentiation.

407.2.3 Hoistway signs. Signs at elevator hoistways shall comply with this Subsection.

407.2.3.1 Floor designation. Floor designations complying with Subsections 703.2 and 703.4.1 shall be provided on both jambs of elevator hoistway entrances. Floor designations shall be provided in both tactile characters and braille. Tactile characters shall be 2 inches high minimum. A tactile star shall be provided on both jambs at the main entry level.

407.2.3.2 Car designations. Destination-oriented elevators shall provide tactile car identification complying with Subsection 703.2 on both jambs of the hoistway immediately below the floor designation. Car designations shall be provided in both tactile characters and braille. Tactile characters shall be 2 inches high minimum.

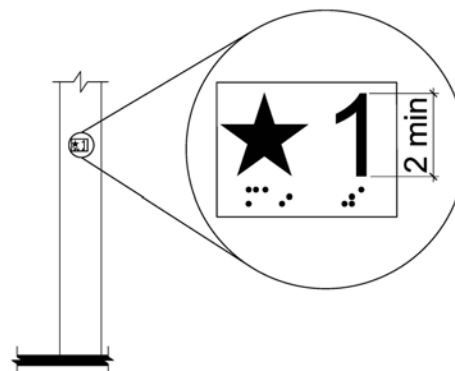


FIGURE 407.2.3.1
FLOOR DESIGNATIONS ON JAMBS OF ELEVATOR HOISTWAY
ENTRANCES

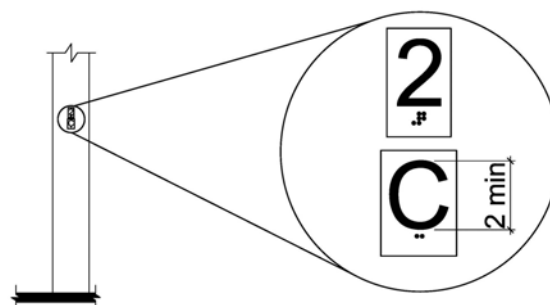


FIGURE 407.2.3.2
CAR DESIGNATIONS ON JAMBS OF DESTINATION-
ORIENTED ELEVATOR HOISTWAY ENTRANCES

407.3 Elevator door requirements. Hoistway and car doors shall comply with this Subsection.

407.3.1 Type. Elevator doors shall be the horizontal sliding type. Car gates shall be prohibited.

407.3.2 Operation. Elevator hoistway and car doors shall open and close automatically.

Exception: Existing manually operated hoistway swing doors shall be permitted provided that they comply with Subsections 404.2.3 and 404.2.9. Car door closing shall not be initiated until the hoistway door is closed.

407.3.3 Reopening device. Elevator doors shall be provided with a reopening device complying with this Subsection that shall stop and reopen a car door and hoistway door automatically if the door becomes obstructed by an object or person.

Exception: Existing elevators with manually operated doors shall not be required to comply with this Subsection.

407.3.3.1 Height. The device shall be activated by sensing an obstruction passing through the opening at 5 inches nominal and 29 inches nominal above the finish floor.

407.3.3.2 Contact. The device shall not require physical contact to be activated, although contact is permitted to occur before the door reverses.

ACCESSIBLE ROUTES

407.3.3.3 Duration. Door reopening devices shall remain effective for 20 seconds minimum.

407.3.4 Door and signal timing. The minimum acceptable time from notification that a car is answering a call or notification of the car assigned at the means for the entry of destination information until the doors of that car start to close shall be calculated from the following equation:

$T = D/(1.5 \text{ ft/s}) = 5 \text{ seconds minimum}$ where T equals the total time in seconds and D equals the distance (in feet or millimeters) from the point in the lobby or corridor 60 inches directly in front of the farthest call button controlling that car to the centerline of its hoistway door.

Exceptions:

1. For cars with in-car lanterns, T shall be permitted to begin when the signal is visible from the point 60 inches directly in front of the farthest hall call button and the audible signal is sounded.
2. Destination-oriented elevators shall not be required to comply with this Subsection.

407.3.5 Door delay. Elevator doors shall remain fully open in response to a car call for 3 seconds minimum.

407.3.6 Width. The width of elevator doors shall comply with Table 407.4.1.

Exception: In existing elevators, a power-operated car door complying with Subsection 404.2.3 shall be permitted.

407.4 Elevator car requirements. Elevator cars shall comply with this Subsection.

407.4.1 Car dimensions. Inside dimensions of elevator cars and clear width of elevator doors shall comply with Table 407.4.1.

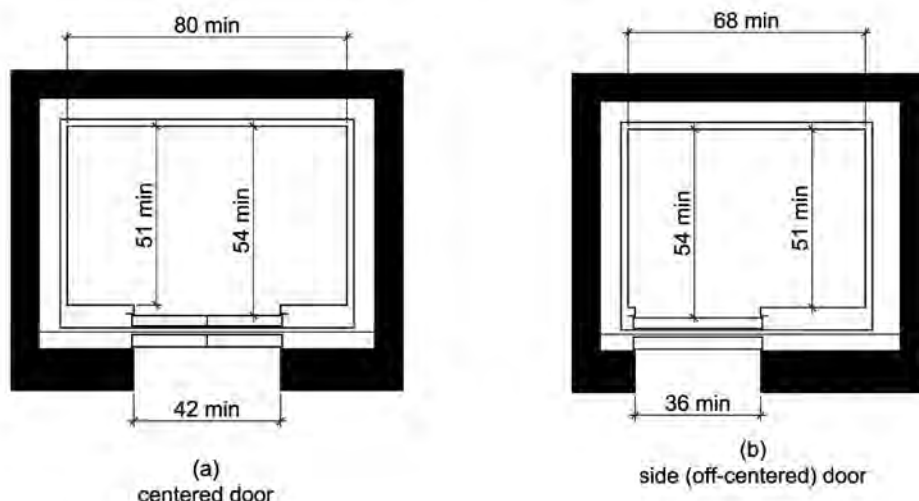
Exception: Existing elevator car configurations that provide a clear floor area of 16 square feet minimum and also provide an inside clear depth 54 inches minimum and a clear width 36 inches minimum shall be permitted.

**TABLE 407.4.1
ELEVATOR CAR DIMENSIONS**

MINIMUM DIMENSIONS				
Door Location	Door Clear Width	Inside Car, Side to Side	Inside Car, Back Wall to Front Return	Inside Car, Back Wall to Inside Face of Door
Centered	42 inches	80 inches	51 inches	54 inches
Side (off-centered)	36 inches ¹	68 inches	51 inches	54 inches
Any	36 inches ¹	54 inches	80 inches	80 inches
Any	36 inches ¹	60 inches ²	60 inches ²	60 inches ²

1. A tolerance of minus $\frac{5}{8}$ -inch is permitted.

2. Other car configurations that provide a turning space complying with Section 304 with the door closed shall be permitted.



**FIGURE 407.4.1
ELEVATOR CAR DIMENSIONS**

(continued)

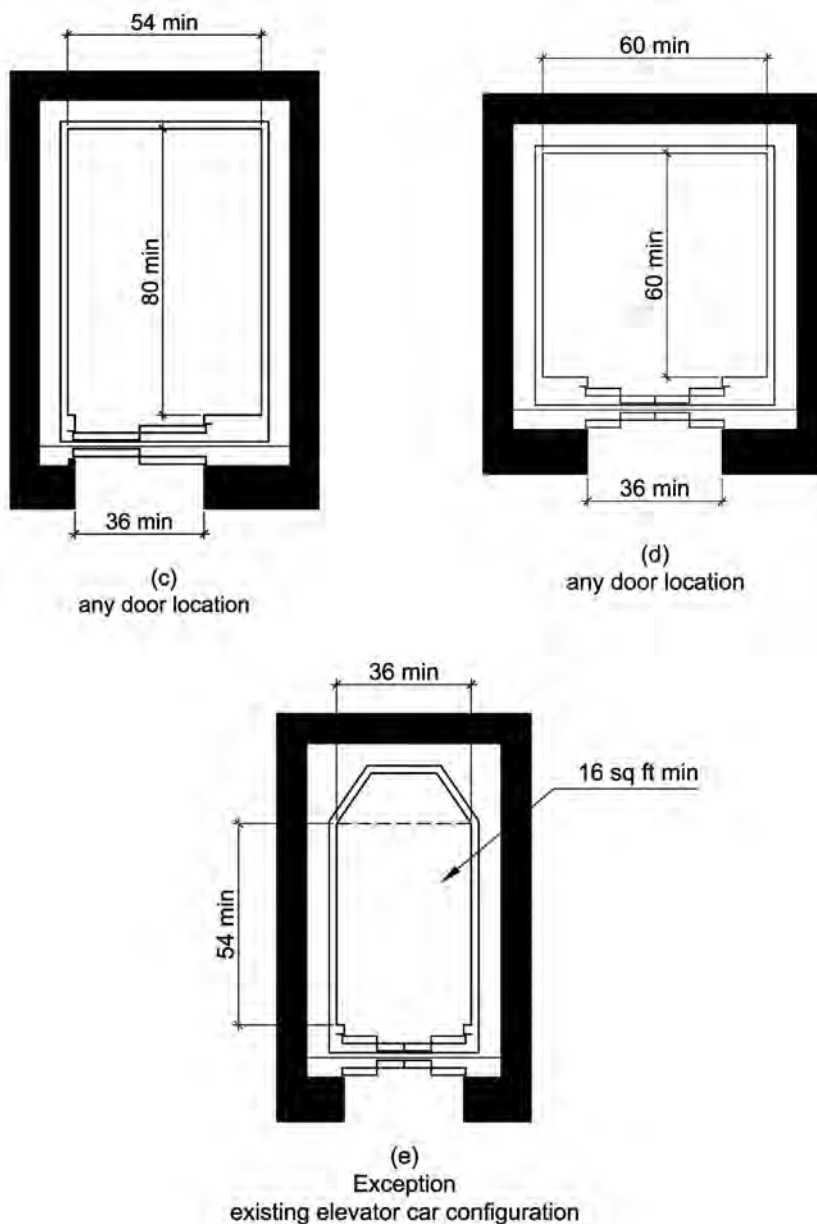


FIGURE 407.4.1—continued
ELEVATOR CAR DIMENSIONS

407.4.2 Floor surfaces. Floor surfaces in elevator cars shall comply with Sections 302 and 303.

407.4.3 Platform to hoistway clearance. The clearance between the car platform sill and the edge of any hoistway landing shall be $1\frac{1}{4}$ inch maximum.

407.4.4 Leveling. Each car shall be equipped with a self-leveling feature that will automatically bring and maintain the car at floor landings within a tolerance of $\frac{1}{2}$ inch under rated loading to zero loading conditions.

407.4.5 Illumination. The level of illumination at the car controls, platform, car threshold and car landing sill shall be 5 foot candles minimum.

407.4.6 Elevator car controls. Where provided, elevator car controls shall comply with this Subsection and Subsection 309.4.

Exception: In existing elevators, where a new car operating panel complying with this Subsection is provided, existing car operating panels shall not be required to comply with this Subsection.

407.4.6.1 Location. Controls shall be located within one of the reach ranges specified in Section 308.

Exceptions:

1. Where the elevator panel serves more than 16 openings and a parallel approach is provided,

buttons with floor designations shall be permitted to be 54 inches maximum above the finish floor.

2. In existing elevators, car control buttons with floor designations shall be permitted to be located 54 inches maximum above the finish floor where a parallel approach is provided.

407.4.6.2 Buttons. Car control buttons with floor designations shall comply with this Subsection and shall be raised or flush.

Exception: In existing elevators, buttons shall be permitted to be recessed.

407.4.6.2.1 Size. Buttons shall be $\frac{3}{4}$ inch minimum in their smallest dimension.

407.4.6.2.2 Arrangement. Buttons shall be arranged with numbers in ascending order. When two or more columns of buttons are provided they shall read from left to right.

407.4.6.3 Keypads. Car control keypads shall be in a standard telephone keypad arrangement and shall comply with Subsection 407.4.7.2.

407.4.6.4 Emergency controls. Emergency controls shall comply with this Subsection.

407.4.6.4.1 Height. Emergency control buttons shall have their centerlines 35 inches minimum above the finish floor.

407.4.6.4.2 Location. Emergency controls, including the emergency alarm, shall be grouped at the bottom of the panel.

407.4.7 Designations and indicators of car controls. Designations and indicators of car controls shall comply with this Subsection.

Exception: In existing elevators, where a new car operating panel complying with this Subsection is provided, existing car operating panels shall not be required to comply with this Subsection.

407.4.7.1 Buttons. Car control buttons shall comply with this Subsection.












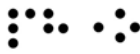
407.4.7.1.1 Type. Control buttons shall be identified by tactile characters complying with Subsection 703.2.

407.4.7.1.2 Location. Raised character and braille designations shall be placed immediately to the left of the control button to which the designations apply.

Exception: Where space on an existing car operating panel precludes tactile markings to the left of the controls, markings shall be placed as near to the control as possible.

407.4.7.1.3 Symbols. The control button for the emergency stop, alarm, door open, door close, main entry floor, and phone, shall be identified with tactile symbols as shown in Table 407.4.7.1.3.

**TABLE 407.4.7.1.3
ELEVATOR CONTROL BUTTON IDENTIFICATION**

Control Button	Tactile Symbol	Braille Message
EMERGENCY STOP		 "ST"OP Three cells
ALARM		 AL"AR"M Four cells
DOOR OPEN		 OP"EN" Three cells
DOOR CLOSE		 CLOSE Five cells
MAIN ENTRY FLOOR		 MA"IN" Three cells
PHONE		 PH"ONE" Four cells

407.4.7.1.4 Visible indicators. Buttons with floor designations shall be provided with visible indicators to show that a call has been registered. The visible indication shall extinguish when the car arrives at the designated floor.

407.4.7.2 Keypads. Keypads shall be identified by characters complying with Subsection 703.5 and shall be centered on the corresponding keypad button. The number five key shall have a single raised dot. The dot shall be 0.118 inch to 0.120 inch base diameter and in other aspects comply with Table 703.3.1.

407.4.8 Car position indicators. Audible and visible car position indicators shall be provided in elevator cars.

407.4.8.1 Visible indicators. Visible indicators shall comply with this Subsection.

407.4.8.1.1 Size. Characters shall be $\frac{1}{2}$ inch high minimum.

407.4.8.1.2 Location. Indicators shall be located above the car control panel or above the door.

407.4.8.1.3 Floor arrival. As the car passes a floor and when a car stops at a floor served by the elevator, the corresponding character shall illuminate.

Exception: Destination-oriented elevators shall not be required to comply with this Subsection

provided that the visible indicators extinguish when the call has been answered.

407.4.8.1.4 Destination indicator. In destination-oriented elevators, a display shall be provided in the car with visible indicators to show car destinations.

407.4.8.2 Audible indicators. Audible indicators shall comply with this Subsection.

407.4.8.2.1 Signal type. The signal shall be an automatic verbal annunciator which announces the floor at which the car is about to stop.

Exception: For elevators other than destination-oriented elevators that have a rated speed of 200 feet per minute or less, a nonverbal audible signal with a frequency of 1,500 Hz maximum which sounds as the car passes or is about to stop at a floor served by the elevator shall be permitted.

407.4.8.2.2 Signal level. The verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the annunciator.

407.4.8.2.3 Frequency. The verbal annunciator shall have a frequency of 300 Hz minimum to 3,000 Hz maximum.

407.4.9 Emergency communication. Emergency two-way communication systems shall comply with Section 308. Tactile symbols and characters shall be provided adjacent to the device and shall comply with Subsection 703.2.

SECTION 408

LIMITED-USE/LIMITED-APPLICATION ELEVATORS

408.1 General. Limited-use/limited-application elevators shall comply with this Section and with ASME A17.1 (incorporated by reference, see “Referenced Standards” in Chapter 1). They shall be passenger elevators as classified by ASME A17.1. Elevator operation shall be automatic.

408.2 Elevator landings. Landings serving limited-use/limited-application elevators shall comply with this Subsection.

408.2.1 Call buttons. Elevator call buttons and keypads shall comply with Subsection 407.2.1.

408.2.2 Hall signals. Hall signals shall comply with Subsection 407.2.2.

408.2.3 Hoistway signs. Signs at elevator hoistways shall comply with Subsection 407.2.3.1.

408.3 Elevator doors. Elevator hoistway doors shall comply with this Subsection.

408.3.1 Sliding doors. Sliding hoistway and car doors shall comply with Subsections 407.3.1 through 407.3.3 and 408.4.1.

408.3.2 Swinging doors. Swinging hoistway doors shall open and close automatically and shall comply with Section 404, Subsections 407.3.2 and 408.3.2.

408.3.2.1 Power operation. Swinging doors shall be power-operated and shall comply with ANSI/BHMA A156.19 (1997 or 2002 edition) (incorporated by reference, see “Referenced Standards” in Chapter 1).

408.3.2.2 Duration. Power-operated swinging doors shall remain open for 20 seconds minimum when activated.

408.4 Elevator cars. Elevator cars shall comply with this Subsection.

408.4.1 Car dimensions and doors. Elevator cars shall provide a clear width 42 inches minimum and a clear depth 54 inches minimum. Car doors shall be positioned at the narrow ends of cars and shall provide 32 inches minimum clear width.

Exceptions:

1. Cars that provide a clear width 51 inches minimum shall be permitted to provide a clear depth 51 inches minimum provided that car doors provide a clear opening 36 inches wide minimum.
2. Existing elevator cars shall be permitted to provide a clear width 36 inches minimum, clear depth 54 inches minimum, and a net clear platform area 15 square feet minimum.

408.4.2 Floor surfaces. Floor surfaces in elevator cars shall comply with Sections 302 and 303.

408.4.3 Platform to hoistway clearance. The platform to hoistway clearance shall comply with Subsection 407.4.3.

408.4.4 Leveling. Elevator car leveling shall comply with Subsection 407.4.4.

408.4.5 Illumination. Elevator car illumination shall comply with Subsection 407.4.5.

408.4.6 Car controls. Elevator car controls shall comply with Subsection 407.4.6. Control panels shall be centered on a side wall.

408.4.7 Designations and indicators of car controls. Designations and indicators of car controls shall comply with Subsection 407.4.7.

408.4.8 Emergency communications. Car emergency signaling devices complying with Subsection 407.4.9 shall be provided.

SECTION 409

PRIVATE RESIDENCE ELEVATORS

409.1 General. Private residence elevators that are provided within a residential dwelling unit required to provide mobility features complying with Subsections 809.2 through 809.4 shall comply with this Section and with ASME A17.1 (incorporated by reference, see “Referenced Standards” in Chapter 1). They shall be passenger elevators as classified by ASME A17.1. Elevator operation shall be automatic.

409.2 Call buttons. Call buttons shall be $\frac{3}{4}$ inch minimum in the smallest dimension and shall comply with Section 309.

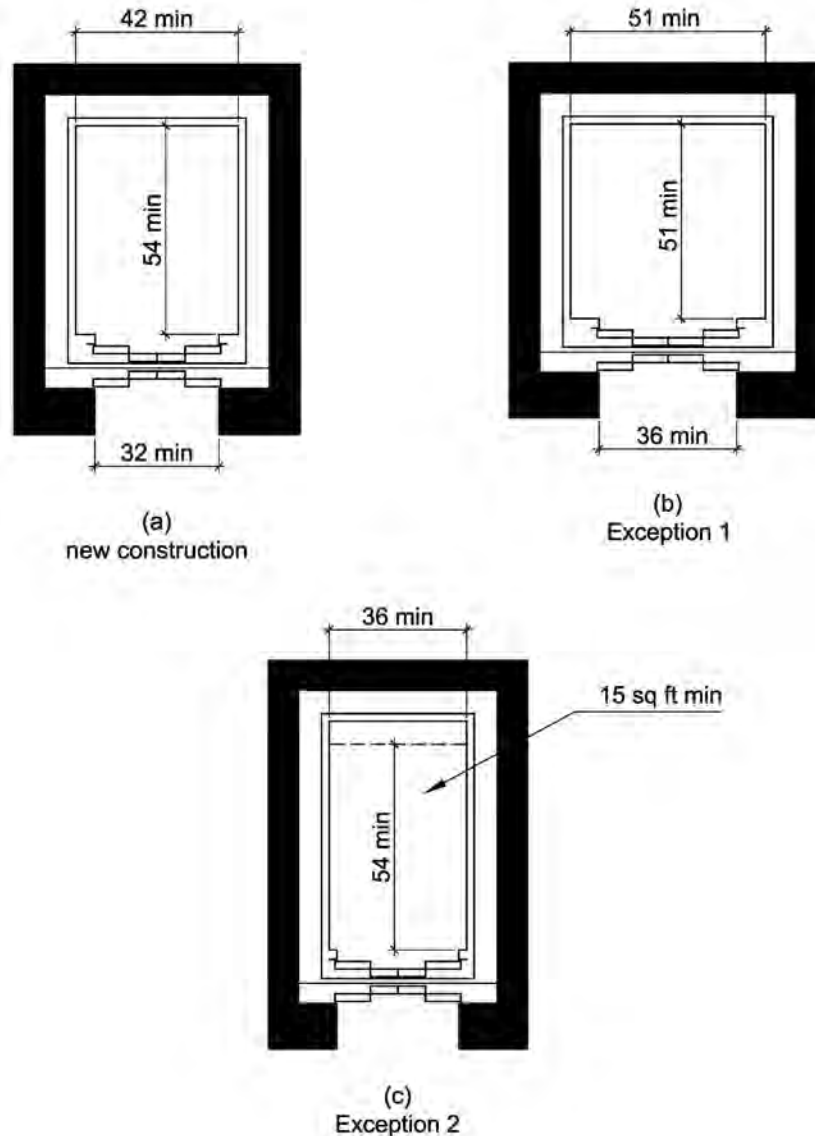


FIGURE 408.4.1
LIMITED-USE/LIMITED-APPLICATION (LULA) ELEVATOR CAR DIMENSIONS

409.3 Elevator doors. Hoistway doors, car doors, and car gates shall comply with Section 404 and this Subsection.

Exception: Doors shall not be required to comply with the maneuvering clearance requirements in Subsection 404.2.4.1 for approaches to the push side of swinging doors.

409.3.1 Power operation. Elevator car and hoistway doors and gates shall be power operated and shall comply with ANSI/BHMA A156.19 (1997 or 2002 edition) (incorporated by reference, see “Referenced Standards” in Chapter 1). Power operated doors and gates shall remain open for 20 seconds minimum when activated.

Exception: In elevator cars with more than one opening, hoistway doors and gates shall be permitted to be of the manual-open, self-close type.

409.3.2 Location. Elevator car doors or gates shall be positioned at the narrow end of the clear floor spaces required by Subsection 409.4.1.

409.4 Elevator cars. Private residence elevator cars shall comply with this Subsection.

409.4.1 Inside dimensions of elevator cars. Elevator cars shall provide a clear floor space of 36 inches minimum by 48 inches minimum and shall comply with Section 305.

409.4.2 Floor surfaces. Floor surfaces in elevator cars shall comply with Sections 302 and 303.

409.4.3 Platform to hoistway clearance. The clearance between the car platform and the edge of any landing sill shall be 1½ inch maximum.

409.4.4 Leveling. Each car shall automatically stop at a floor landing within a tolerance of $\frac{1}{2}$ inch under rated loading to zero loading conditions.

409.4.5 Illumination levels. Elevator car illumination shall comply with this Subsection.

409.4.6 Car controls. Elevator car control buttons shall comply with Subsections 309.3, 309.4, and this Subsection shall be raised or flush.

409.4.6.1 Size. Control buttons shall be $\frac{3}{4}$ inch minimum in their smallest dimension.

409.4.6.2 Location. Control panels shall be on a side wall, 12 inches minimum from any adjacent wall.

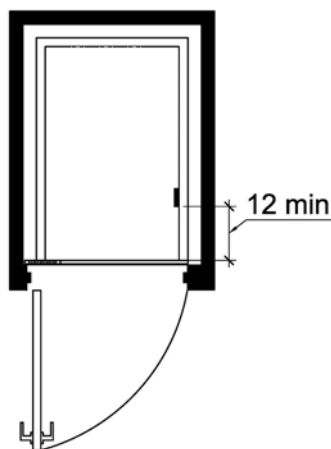


FIGURE 409.4.6.2
LOCATION OF PRIVATE RESIDENCE
ELEVATOR CONTROL PANEL

409.4.7 Emergency communications. Emergency two-way communication systems shall comply with this Subsection.

409.4.7.1 Type. A telephone and emergency signal device shall be provided in the car.

409.4.7.2 Operable parts. The telephone and emergency signaling device shall comply with Subsections 309.3 and 309.4.

409.4.7.3 Compartment. If the telephone or device is in a closed compartment, the compartment door hardware shall comply with Section 309.

409.4.7.4 Cord. The telephone cord shall be 29 inches long minimum.

SECTION 410 **PLATFORM LIFTS**

410.1 General. Platform lifts shall comply with ASME A18.1 (1999 edition or 2003 edition) (incorporated by reference, see "Referenced Standards" in Chapter 1). Platform lifts shall not be attendant-operated and shall provide unassisted entry and exit from the lift.

Advisory 410.1 General. Inclined stairway chairlifts and inclined and vertical platform lifts are available for short-distance vertical transportation. Because an accessible route requires an 80 inch vertical clearance, care should be taken in selecting lifts as they may not be equally suitable for use by people using wheelchairs and people standing. If a lift does not provide 80 inch vertical clearance, it cannot be considered part of an accessible route in new construction.

The ADA and other Federal civil rights laws require that accessible features be maintained in working order so that they are accessible to and usable by those people they are intended to benefit. Building owners are reminded that the ASME A18 *Safety Standard for Platform Lifts and Stairway Chairlifts* requires routine maintenance and inspections. Isolated or temporary interruptions in service due to maintenance or repairs may be unavoidable; however, failure to take prompt action to effect repairs could constitute a violation of Federal laws and these requirements.

410.2 Floor surfaces. Floor surfaces in platform lifts shall comply with Sections 302 and 303.

410.3 Clear floor space. Clear floor space in platform lifts shall comply with Section 305.

410.4 Platform to runway clearance. The clearance between the platform sill and the edge of any runway landing shall be 1 inch maximum.

410.5 Operable parts. Controls for platform lifts shall comply with Section 309.

410.6 Doors and gates. Platform lifts shall have low-energy power-operated doors or gates complying with Subsection 404.3. Doors shall remain open for 20 seconds minimum. End doors and gates shall provide a clear width 32 inches minimum. Side doors and gates shall provide a clear width 42 inches minimum.

Exception: Platform lifts serving two landings maximum and having doors or gates on opposite sides shall be permitted to have self-closing manual doors or gates.

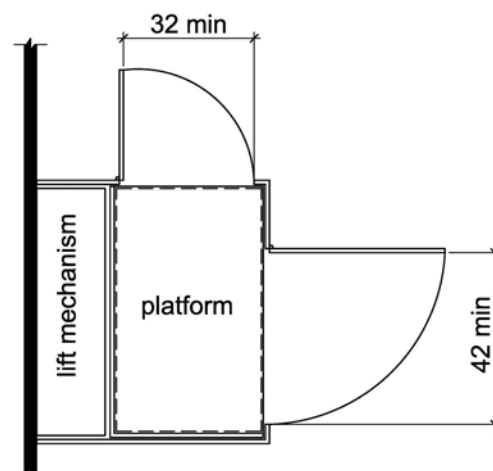


FIGURE 410.6
PLATFORM LIFT DOORS AND GATES

CHAPTER 5

GENERAL SITE AND BUILDING ELEMENTS

SECTION 501 GENERAL

501.1 Scope. The provisions of this Chapter shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

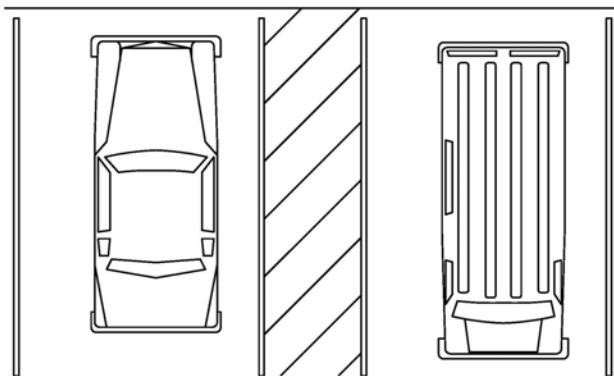
SECTION 502 PARKING SPACES

502.1 General. Car and van parking spaces shall comply with Section 502. Where parking spaces are marked with lines, width measurements of parking spaces and access aisles shall be made from the centerline of the markings.

Exception: Where parking spaces or access aisles are not adjacent to another parking space or access aisle, measurements shall be permitted to include the full width of the line defining the parking space or access aisle.

502.2 Vehicle spaces. Each parking space must be at least 12 feet wide, shall be marked to define the width, and shall have an adjacent access aisle complying with Subsection 502.3. See Subsection 406.5 curb ramp location.

Exception: For on-street parallel parking spaces and theme parks or an entertainment complex in which are provided continuous attendant services or designated lots for parking by persons who have disabilities: car parking spaces shall be permitted to be 96 inches wide minimum; van parking spaces shall be permitted to be 96 inches wide minimum where the access aisle is 96 inches wide minimum and shall be designated “van accessible”; alternatively, van parking spaces shall be permitted to be 132 inches wide minimum where the access aisle is 60 inches wide minimum and shall be designated “van accessible.”



**FIGURE 502.2
VEHICLE PARKING SPACES**

Advisory 502.2 Vehicle Spaces. Pursuant to Section 553.512, F.S., Florida requirements, except Section 553.041(c)1 parking space and access aisle width, may be waived down to the requirements of the *ADA Standards for Accessible Design*. No waivers are required for on-street parallel parking spaces and theme parks or an entertainment complex in which are provided continuous attendant services or designated lots for parking by persons who have disabilities pursuant to Subsections 553.041(5)(c)3. and (d), F.S., and the Exception to this Subsection.

502.2.1 On-street parallel parking. Spaces must comply with Section 208 and this Section of the *ADA Standards for Accessible Design*. Curbs adjacent to such spaces must be of a height that does not interfere with the opening and closing of motor vehicle doors.

502.3 Access aisle. Access aisles serving parking spaces shall comply with this Subsection. Access aisles shall adjoin an accessible route. Two parking spaces shall be permitted to share a common access aisle.

Parking access aisles must be part of an accessible route to the building or facility entrance. Access aisles must be placed adjacent to accessible parking spaces. All spaces must be located on an accessible route that is at least 44 inches wide so that users are not compelled to walk or wheel behind parked vehicles except behind his or her own vehicle.

Exception: Access aisles are not required for on-street parallel parking.

Advisory 502.3 Access aisle. Accessible routes must connect parking spaces to accessible entrances. In parking facilities where the accessible route must cross vehicular traffic lanes, marked crossings enhance pedestrian safety, particularly for people using wheelchairs and other mobility aids.

Florida law, Section 553.5041(5)(a), F.S., requires placement of accessible routes such that persons with disabilities are not compelled to walk or wheel behind parked vehicles other than their own vehicle. Florida law, Section 553.5041(5)(d), F.S., allows on-street accessible parking to not have an access aisle.

502.3.1 Width. Access aisles serving car and van parking spaces shall be 60 inches wide minimum.

502.3.2 Length. Access aisles shall extend the full length of the parking spaces they serve.

502.3.3 Marking. Access aisles shall be marked so as to discourage parking in them.

The access aisle must be striped diagonally to designate it as a no-parking zone.

Advisory 502.3.3 Marking. The method and color of marking are not specified by these requirements but may be addressed by State or local laws or regulations. Because these requirements permit the van access aisle to be as wide as a parking space, it is important that the aisle be clearly marked.

Florida law, Section 553.5041(5)(c)1., requires diagonal striping of access aisles.

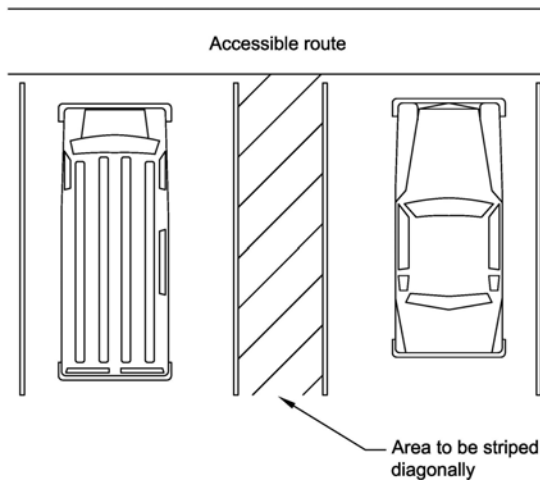


FIGURE 502.3
PARKING SPACE ACCESS AISLE

502.3.4 Location. Access aisles shall not overlap the vehicular way. Access aisles shall be permitted to be placed on either side of the parking space except for angled van parking spaces which shall have access aisles located on the passenger side of the parking spaces.

Advisory 502.3.4 Location. Wheelchair lifts typically are installed on the passenger side of vans. Many drivers, especially those who operate vans, find it more difficult to back into parking spaces than to back out into comparatively unrestricted vehicular lanes. For this reason, where a van and car share an access aisle, consider locating the van space so that the access aisle is on the passenger side of the van space.

502.4 Floor or ground surfaces. Parking spaces and access aisles serving them shall comply with Section 302. Access aisles shall be at the same level as the parking spaces they serve. Changes in level are not permitted.

Exception: Slopes not steeper than 1:48 shall be permitted.

Advisory 502.4 Floor or ground surfaces. Access aisles are required to be nearly level in all directions to provide a surface for wheelchair transfer to and from vehicles. The exception allows sufficient slope for drainage. Built-up curb ramps are not permitted to project into access aisles and parking spaces because they would create slopes greater than 1:48.

502.5 Vertical clearance. Parking spaces for vans and access aisles and vehicular routes serving them shall provide a vertical clearance of 98 inches minimum.

Every nonresidential structure built on or after January 1, 1991, which is designed to use covered or underground parking as the primary available parking space shall design the covered or underground parking facility to maintain a minimum height for the portion of the street-accessible level of the parking facility directly over van-accessible parking spaces and for providing ingress and egress to such parking spaces of at least 8 feet 2 inches. Signs shall be posted to warn operators of handicap-equipped vans that they cannot pass beyond a certain point due to height limitations. If compliance with this minimum height clearance requirement will cause the structure to exceed local height limitations imposed by local zoning, planning, or fire ordinances, or will result in the imposition of any additional requirements of such ordinances, the structure may exceed the height limitation specified in those particular codes as necessary to comply with the requirements of this Section and is exempt from such additional requirements. Structures for which the plans were sealed by an architect prior to January 1, 1991, are exempt from this Section.

Advisory 502.5 Vertical clearance. Signs provided at entrances to parking facilities informing drivers of clearances and the location of van accessible parking spaces can provide useful customer assistance.

Florida law, Section 553.511, F.S., requires signs be posted that will warn handicapped-equipped van operators of height limitations so they will not pass beyond a point where the van cannot be maneuvered.

Florida law also preempts local government height restriction ordinances that would prohibit compliance with the minimum height requirements of this Section. Also, any local or state law or regulation that prohibits a covered entity from complying with requirements of the ADA may render such jurisdiction in violation of the ADA.

502.6 Identification. Parking space identification signs shall include the International Symbol of Accessibility complying with Subsection 703.7.2.1. Signs identifying van parking spaces when required by Subsection 502.2 shall contain the designation “van accessible.”

Advisory 502.6 identification. The required “van accessible” designation is intended to be informative, not restrictive, in identifying those spaces that are better suited for van use. Enforcement of motor vehicle laws, including parking privileges, is a local matter.

Parking space and access aisle configurations required for all accessible parking by Florida law, Section 553.5041, F.S., meet the van accessible space requirements of the *ADA Standards for Accessible Design*. Therefore, no accessible space is more suitable than any other accessible space for “van accessible” parking. Florida law only requires “van accessible” parking signs in parking structures where van parking may be limited to the first level accessible spaces.

Florida accessible parking signs must include indication of the penalty for illegal parking in addition to the accessible parking symbol required by the *ADA Standards for Accessible Design*.

502.6.1 Each such parking space must be striped in a manner that is consistent with the standards of the controlling jurisdiction for other spaces and prominently outlined with blue paint, and must be repainted when necessary, to be clearly distinguishable as a parking space designated for persons who have disabilities. The space must be posted with a permanent above-grade sign of a color and design approved by the Department of Transportation, which is placed on or at least 60 inches above the finished floor or ground surface measured to the bottom of the sign and which bears the international symbol of accessibility and the caption "PARKING BY DISABLED PERMIT ONLY." Such a sign, erected after October 1, 1996, must indicate the penalty for illegal use of the space. Any provision of this Section to the contrary notwithstanding, in a theme park or an entertainment complex as defined in Section 509.013 in which accessible parking is located in designated lots or areas, the signage indicating the lot as reserved for accessible parking may be located at the entrances to the lot in lieu of a sign at each parking place.

502.7 Relationship to accessible routes. Parking spaces and access aisles shall be designed so that cars and vans, when parked, cannot obstruct the required clear width of adjacent accessible routes.

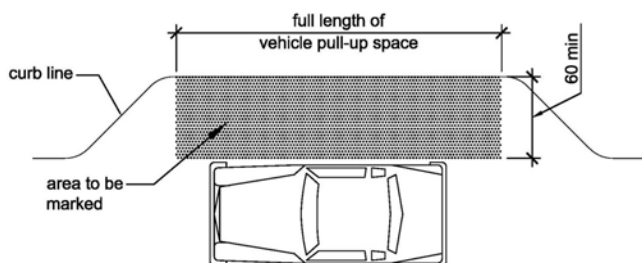
Advisory 502.7 Relationship to accessible routes. Wheel stops are an effective way to prevent vehicle overhangs from reducing the clear width of accessible routes.

SECTION 503 PASSENGER LOADING ZONES

503.1 General. Passenger loading zones shall comply with this Section.

503.2 Vehicle pull-up space. Passenger loading zones shall provide a vehicular pull-up space 96 inches wide minimum and 20 feet long minimum.

503.3 Access aisle. Passenger loading zones shall provide access aisles complying with this Section adjacent to the vehicle pull-up space. Access aisles shall adjoin an accessible route and shall not overlap the vehicular way.



**FIGURE 503.3
PASSENGER LOADING ZONE ACCESS AISLE**

503.3.1 Width. Access aisles serving vehicle pull-up spaces shall be 60 inches wide minimum.

503.3.2 Length. Access aisles shall extend the full length of the vehicle pull-up spaces they serve.

503.3.3 Marking. Access aisles shall be marked so as to discourage parking in them.

503.4 Floor and ground surfaces. Vehicle pull-up spaces and access aisles serving them shall comply with Section 302. Access aisles shall be at the same level as the vehicle pull-up space they serve. Changes in level are not permitted.

Exception: Slopes not steeper than 1:48 shall be permitted.

503.5 Vertical clearance. Vehicle pull-up spaces, access aisles serving them, and a vehicular route from an entrance to the passenger loading zone, and from the passenger loading zone to a vehicular exit shall provide a vertical clearance of 114 inches minimum.

SECTION 504 STAIRWAYS

504.1 General. Stairs shall comply with this Section.

504.2 Treads and risers. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Risers shall be 4 inches high minimum and 7 inches high maximum. Treads shall be 11 inches deep minimum.

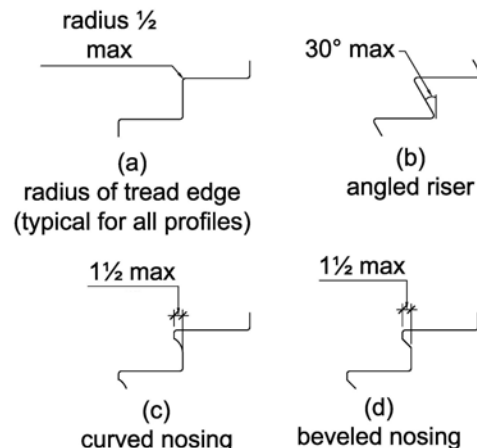
504.3 Open risers. Open risers are not permitted.

504.4 Tread surface. Stair treads shall comply with Section 302. Changes in level are not permitted.

Exception: Treads shall be permitted to have a slope not steeper than 1:48.

Advisory 504.4 Tread surface. Consider providing visual contrast on tread nosings, or at the leading edges of treads without nosings, so that stair treads are more visible for people with low vision.

504.5 Nosings. The radius of curvature at the leading edge of the tread shall be $\frac{1}{2}$ inch maximum. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. Risers shall be permitted to slope under the tread at an angle of 30 degrees maximum from vertical. The permitted projection of the nosing shall extend $1\frac{1}{2}$ inches maximum over the tread below.



**FIGURE 504.5
STAIR NOSINGS**

504.6 Handrails. Stairs shall have handrails complying with Section 505.

504.7 Wet conditions. Stair treads and landings subject to wet conditions shall be designed to prevent the accumulation of water.

SECTION 505 HANDRAILS

505.1 General. Handrails provided along walking surfaces complying with Section 403, required at ramps complying with Section 405, and required at stairs complying with Section 504 shall comply with this Section.

Advisory 505.1 General. Handrails are required on ramp runs with a rise greater than 6 inches (see Subsection 405.8) and on certain stairways (see Section 504). Handrails are not required on walking surfaces with running slopes less than 1:20. However, handrails are required to comply with this Section when they are provided on walking surfaces with running slopes less than 1:20 (see Subsection 403.6). Subsections 505.2, 505.3, and 505.10 do not apply to handrails provided on walking surfaces with running slopes less than 1:20 as these sections only reference requirements for ramps and stairs.

505.2 Where required. Handrails shall be provided on both sides of stairs and ramps.

Exception: In assembly areas, handrails shall not be required on both sides of aisle ramps where a handrail is provided at either side or within the aisle width.

505.3 Continuity. Handrails shall be continuous within the full length of each stair flight or ramp run. Inside handrails on switchback or dogleg stairs and ramps shall be continuous between flights or runs.

Exception: In assembly areas, handrails on ramps shall not be required to be continuous in aisles serving seating.

505.4 Height. Top of gripping surfaces of handrails shall be 34 inches minimum and 38 inches maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces.

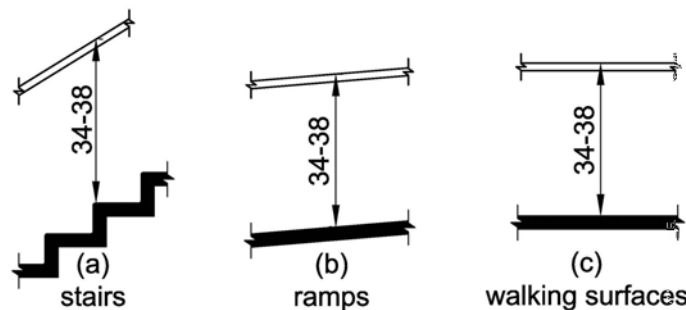


FIGURE 505.4
HANDRAIL HEIGHT

Advisory 505.4 Height. The requirements for stair and ramp handrails in this code are for adults. When children are the principal users in a building or facility (e.g., elementary schools), a second set of handrails at an appropriate height can assist them and aid in preventing accidents. A maximum height of 28 inches measured to the top of the gripping surface from the ramp surface or stair nosing is recommended for handrails designed for children. Sufficient vertical clearance between upper and lower handrails, 9 inches minimum, should be provided to help prevent entrapment.

505.5 Clearance. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1½ inches minimum.

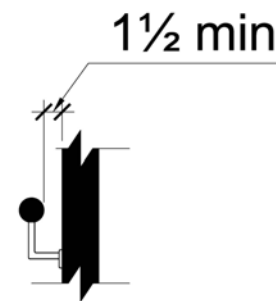


FIGURE 505.5
HANDRAIL CLEARANCE

505.6 Gripping surface. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1½ inches minimum below the bottom of the handrail gripping surface.

Exceptions:

1. Where handrails are provided along walking surfaces with slopes not steeper than 1:20, the bottoms of handrail gripping surfaces shall be permitted to be

obstructed along their entire length where they are integral to crash rails or bumper guards.

- The distance between horizontal projections and the bottom of the gripping surface shall be permitted to be reduced by $\frac{1}{8}$ inch for each $\frac{1}{2}$ inch of additional handrail perimeter dimension that exceeds 4 inches.

Advisory 505.6 Gripping surface. People with disabilities, older people, and others benefit from continuous gripping surfaces that permit users to reach the fingers outward or downward to grasp the handrail, particularly as the user senses a loss of equilibrium or begins to fall.

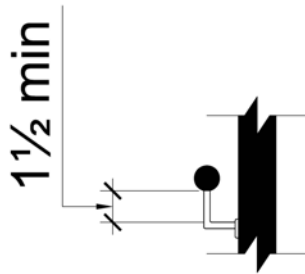


FIGURE 505.6
HORIZONTAL PROJECTIONS BELOW GRIPPING SURFACE

505.7 Cross section. Handrail gripping surfaces shall have a cross section complying with Subsection 505.7.1 or 505.7.2.

505.7.1 Circular cross section. Handrail gripping surfaces with a circular cross section shall have an outside diameter of $1\frac{1}{4}$ inches minimum and 2 inches maximum.

505.7.2 Noncircular cross sections. Handrail gripping surfaces with a noncircular cross section shall have a perimeter dimension of 4 inches minimum and $6\frac{1}{4}$ inches maximum, and a cross-section dimension of $2\frac{1}{4}$ inches maximum.

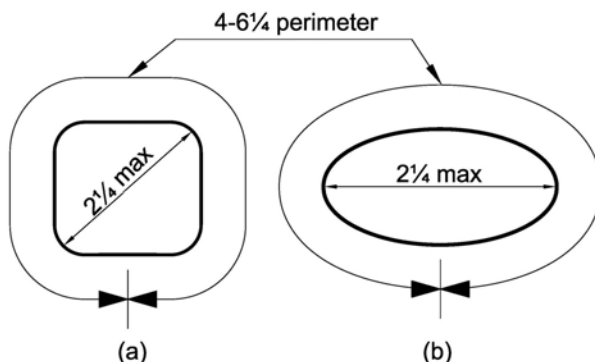


FIGURE 505.7.2
HANDRAIL NONCIRCULAR CROSS SECTION

505.8 Surfaces. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.

505.9 Fittings. Handrails shall not rotate within their fittings.

505.10 Handrail extensions. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with this Subsection.

Exceptions:

- Extensions shall not be required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
- In assembly areas, extensions shall not be required for ramp handrails in aisles serving seating where the handrails are discontinuous to provide access to seating and to permit crossovers within aisles.
- In alterations, full extensions of handrails shall not be required where such extensions would be hazardous due to plan configuration.

505.10.1 Top and bottom extension at ramps. Ramp handrails shall extend horizontally above the landing for 12 inches minimum beyond the top and bottom of ramp runs. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent ramp run.

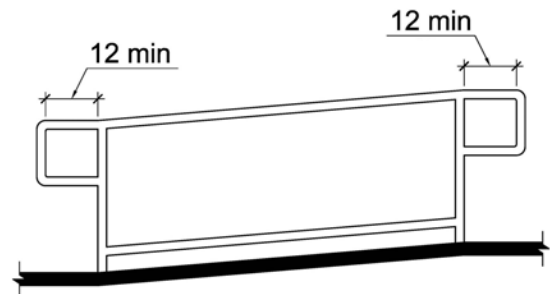


FIGURE 505.10.1
TOP AND BOTTOM HANDRAIL EXTENSION AT RAMPS

505.10.2 Top extension at stairs. At the top of a stair flight, handrails shall extend horizontally above the landing for 12 inches minimum beginning directly above the first riser nosing. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight.

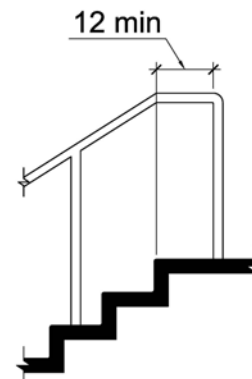
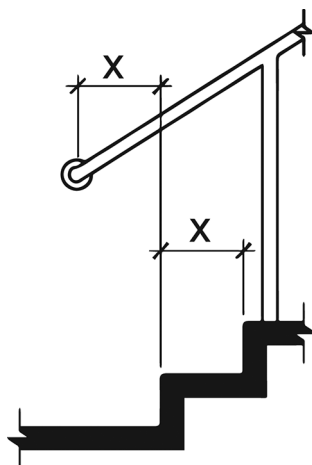


FIGURE 505.10.2
TOP HANDRAIL EXTENSION AT STAIRS

505.10.3 Bottom extension at stairs. At the bottom of a stair flight, handrails shall extend at the slope of the stair flight for a horizontal distance at least equal to one tread depth beyond the last riser nosing. Extension shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight.



Note: X = tread depth

FIGURE 505.10.3
BOTTOM HANDRAIL EXTENSION AT STAIRS

CHAPTER 6

PLUMBING ELEMENTS AND FACILITIES

SECTION 601 GENERAL

601.1 Scope. The provisions of this Chapter shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

SECTION 602 DRINKING FOUNTAINS

602.1 General. Drinking fountains shall comply with Section 307 and this Section.

602.2 Clear floor space. Units shall have a clear floor or ground space complying with Section 305 positioned for a forward approach and centered on the unit. Knee and toe clearance complying with Section 306 shall be provided.

Exception: A parallel approach complying with Section 305 shall be permitted at units for children's use where the spout is 30 inches maximum above the finish floor or ground and is 3½ inches maximum from the front edge of the unit, including bumpers.

602.3 Operable parts. Operable parts shall comply with Section 309.

602.4 Spout height. Spout outlets shall be 36 inches maximum above the finish floor or ground.

602.5 Spout location. The spout shall be located 15 inches minimum from the vertical support and 5 inches maximum from the front edge of the unit, including bumpers.

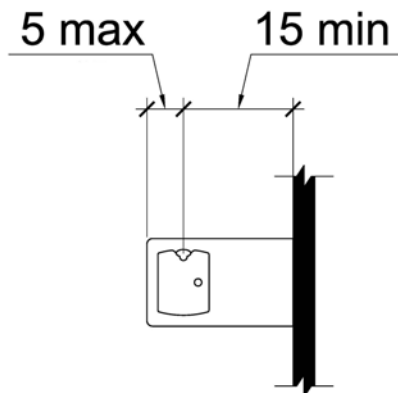


FIGURE 602.5
DRINKING FOUNTAIN SPOUT LOCATION

602.6 Water flow. The spout shall provide a flow of water 4 inches high minimum and shall be located 5 inches maximum from the front of the unit. The angle of the water stream shall be measured horizontally relative to the front face of the unit. Where spouts are located less than 3 inches of the front of the unit, the angle of the water stream shall be 30 degrees maxi-

um. Where spouts are located between 3 inches and 5 inches maximum from the front of the unit, the angle of the water stream shall be 15 degrees maximum.

Advisory 602.6 Water flow. The purpose of requiring the drinking fountain spout to produce a flow of water 4 inches high minimum is so that a cup can be inserted under the flow of water to provide a drink of water for an individual who, because of a disability, would otherwise be incapable of using the drinking fountain.

602.7 Drinking fountains for standing persons. Spout outlets of drinking fountains for standing persons shall be 38 inches minimum and 43 inches maximum above the finish floor or ground.

SECTION 603 TOILET AND BATHING ROOMS

603.1 General. Toilet and bathing rooms shall comply with this Section.

603.2 Clearances. Clearances shall comply with this Subsection.

603.2.1 Turning space. Turning space complying with Section 304 shall be provided within the room.

603.2.2 Overlap. Required clear floor spaces, clearance at fixtures, and turning space shall be permitted to overlap.

603.2.3 Door swing. Doors shall not swing into the clear floor space or clearance required for any fixture. Doors shall be permitted to swing into the required turning space.

Exceptions:

1. Doors to a toilet room or bathing room for a single occupant accessed only through a private office and not for common use or public use shall be permitted to swing into the clear floor space or clearance provided the swing of the door can be reversed to comply with this Subsection.
2. Where the toilet room or bathing room is for individual use and a clear floor space complying with Subsection 305.3 is provided within the room beyond the arc of the door swing, doors shall be permitted to swing into the clear floor space or clearance required for any fixture.

Advisory 603.2.3 Door swing Exception 1. At the time the door is installed, and if the door swing is reversed in the future, the door must meet all the requirements specified in Section 404. Additionally, the door swing cannot reduce the required width of an accessible route. Also, avoid violating other building or life safety codes when the door swing is reversed.

603.3 Mirrors. Mirrors located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface 40 inches maximum above the finish floor or ground. Mirrors not located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface 35 inches maximum above the finish floor or ground.

Advisory 603.3 Mirrors. A single full-length mirror can accommodate a greater number of people, including children. In order for mirrors to be usable by people who are ambulatory and people who use wheelchairs, the top edge of mirrors should be 74 inches minimum from the floor or ground.

603.4 Coat hooks and shelves. Coat hooks shall be located within one of the reach ranges specified in Section 308. Shelves shall be located 40 inches minimum and 48 inches maximum above the finish floor.

SECTION 604 WATER CLOSETS AND TOILET COMPARTMENTS

604.1 General. Water closets and toilet compartments shall comply with Subsections 604.2 through 604.8.

Exception: Water closets and toilet compartments for children's use shall be permitted to comply with Subsection 604.9.

604.2 Location. The water closet shall be positioned with a wall or partition to the rear and to one side. The centerline of the water closet shall be 16 inches minimum to 18 inches maximum from the side wall or partition, except that the water closet shall be 17 inches minimum and 19 inches maximum from the side wall or partition in the ambulatory accessible toilet compartment specified in Subsection 604.8.2. Water closets shall be arranged for a left-hand or right-hand approach.

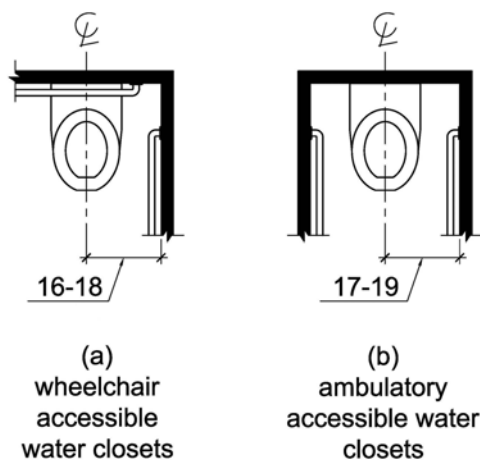


FIGURE 604.2
WATER CLOSET LOCATION

604.3 Clearance. Clearances around water closets and in toilet compartments shall comply with this Subsection.

604.3.1 Size. Clearance around a water closet shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall.

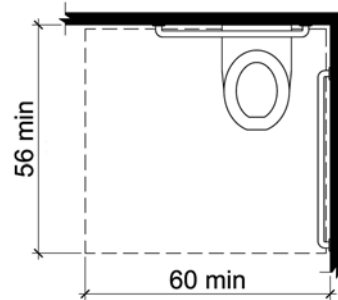


FIGURE 604.3.1
SIZE OF CLEARANCE AT WATER CLOSETS

604.3.2 Overlap. The required clearance around the water closet shall be permitted to overlap the water closet, associated grab bars, dispensers, sanitary napkin disposal units, coat hooks, shelves, accessible routes, clear floor space and clearances required at other fixtures, and the turning space. No other fixtures or obstructions shall be located within the required water closet clearance.

Exception: In residential dwelling units, a lavatory complying with Section 606 shall be permitted on the rear wall 18 inches minimum from the water closet centerline where the clearance at the water closet is 66 inches minimum measured perpendicular from the rear wall.

Advisory 604.3.2 Overlap. When the door to the toilet room is placed directly in front of the water closet, the water closet cannot overlap the required maneuvering clearance for the door inside the room.

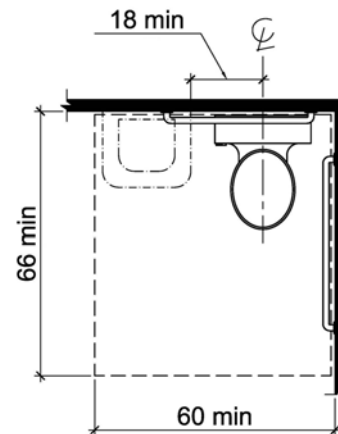


FIGURE 604.3.2 (EXCEPTION)
OVERLAP OF WATER CLOSET CLEARANCE
IN RESIDENTIAL DWELLING UNITS

604.4 Seats. The seat height of a water closet above the finish floor shall be 17 inches minimum and 19 inches maximum

measured to the top of the seat. Seats shall not be sprung to return to a lifted position.

Exceptions:

1. A water closet in a toilet room for a single occupant accessed only through a private office and not for common use or public use shall not be required to comply with this Subsection.
2. In residential dwelling units, the height of water closets shall be permitted to be 15 inches minimum and 19 inches maximum above the finish floor measured to the top of the seat.

604.5 Grab bars. Grab bars for water closets shall comply with Section 609. Grab bars shall be provided on the side wall closest to the water closet and on the rear wall.

Exceptions:

1. Grab bars shall not be required to be installed in a toilet room for a single occupant accessed only through a private office and not for common use or public use provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with this Subsection.
2. In residential dwelling units, grab bars shall not be required to be installed in toilet or bathrooms provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with this Subsection.
3. In detention or correction facilities, grab bars shall not be required to be installed in housing or holding cells that are specially designed without protrusions for purposes of suicide prevention.

Advisory 604.5 Grab bars Exception 2. Reinforcement must be sufficient to permit the installation of rear and side wall grab bars that fully meet all accessibility requirements including, but not limited to, required length, installation height, and structural strength.

604.5.1 Side wall. The side wall grab bar shall be 42 inches long minimum, located 12 inches maximum from the rear wall and extending 54 inches minimum from the rear wall.

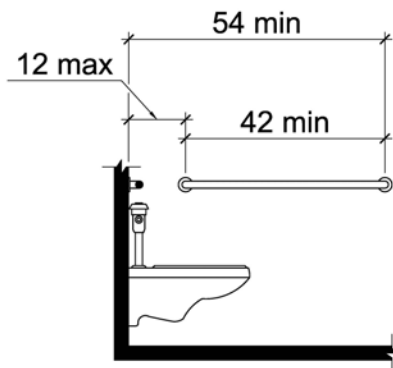


FIGURE 604.5.1
SIDE WALL GRAB BAR AT WATER CLOSETS

604.5.2 Rear wall. The rear wall grab bar shall be 36 inches long minimum and extend from the centerline of the water closet 12 inches minimum on one side and 24 inches minimum on the other side.

Exceptions:

1. The rear grab bar shall be permitted to be 24 inches long minimum, centered on the water closet, where wall space does not permit a length of 36 inches minimum due to the location of a recessed fixture adjacent to the water closet.
2. Where an administrative authority requires flush controls for flush valves to be located in a position that conflicts with the location of the rear grab bar, then the rear grab bar shall be permitted to be split or shifted to the open side of the toilet area.

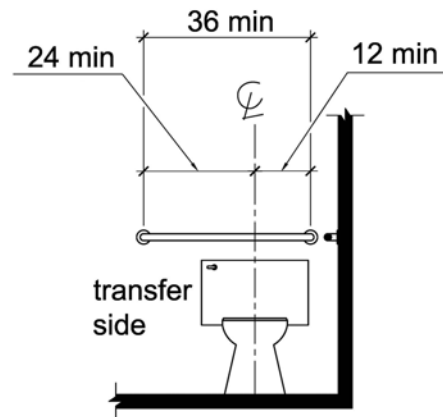


FIGURE 604.5.2
REAR WALL GRAB BAR WATER CLOSETS

604.6 Flush controls. Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with Section 309. Flush controls shall be located on the open side of the water closet except in ambulatory accessible compartments complying with Subsection 604.8.2.

Advisory 604.6 Flush controls. If plumbing valves are located directly behind the toilet seat, flush valves and related plumbing can cause injury or imbalance when a person leans back against them. To prevent causing injury or imbalance, the plumbing can be located behind walls or to the side of the toilet; or if approved by the local authority having jurisdiction, provide a toilet seat lid.

604.7 Dispensers. Toilet paper dispensers shall comply with Subsection 309.4 and shall be 7 inches minimum and 9 inches maximum in front of the water closet measured to the centerline of the dispenser. When combination dispensers are used, the minimum/maximum dimensions above shall apply to the dispenser furthest from the water closet. The outlet of the dispenser shall be 15 inches minimum and 48 inches maximum above the finish floor and shall not be located behind grab

bars. Other dispenser outlets and dispenser controls located at the water closet shall comply with the above dimensions. All dispensers shall be located such that a minimum of 1½-inch clearance is provided below grab bars and a minimum of 12-inch clearance is provided above grab bars, except that flush mounted dispensers need not comply with the 12 inches minimum clearance above grab bars. Dispensers shall not be of a type that controls delivery or that does not allow continuous paper flow.

Advisory 604.7 Dispensers. If toilet paper dispensers are installed above the side wall grab bar, the outlet of the toilet paper dispenser must be 48 inches maximum above the finish floor and the top of the gripping surface of the grab bar must be 33 inches minimum and 36 inches maximum above the finish floor.

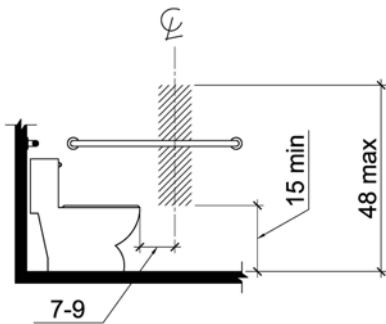


FIGURE 604.7
DISPENSER OUTLET LOCATION

604.8 Toilet compartments. Wheelchair accessible toilet compartments shall meet the requirements of Subsections 604.8.1 and 604.8.3. Compartments containing more than one plumbing fixture shall comply with Section 603. Ambulatory accessible compartments shall comply with Subsections 604.8.2 and 604.8.3.

604.8.1 Wheelchair accessible compartments. Wheelchair accessible compartments shall comply with this Subsection.

604.8.1.1 Size. Wheelchair accessible compartments shall be 60 inches wide minimum measured perpendicular to the side wall, and 56 inches deep minimum for wall hung water closets and 59 inches deep minimum for floor mounted water closets measured perpendicular to the rear wall. Wheelchair accessible compartments for children's use shall be 60 inches wide minimum measured perpendicular to the side wall, and 59 inches deep minimum for wall hung and floor mounted water closets measured perpendicular to the rear wall.

Advisory 604.8.1.1 Size. The minimum space required in toilet compartments is provided so that a person using a wheelchair can maneuver into position at the water closet. This space cannot be obstructed by baby changing tables or other fixtures or conveniences, except as specified at Subsection 604.3.2 (Overlap). If toilet compartments are to be used to house fixtures other than those associated with the

water closet, they must be designed to exceed the minimum space requirements. Convenience fixtures such as baby changing tables must also be accessible to people with disabilities as well as to other users. Toilet compartments that are designed to meet, and not exceed, the minimum space requirements may not provide adequate space for maneuvering into position at a baby changing table.

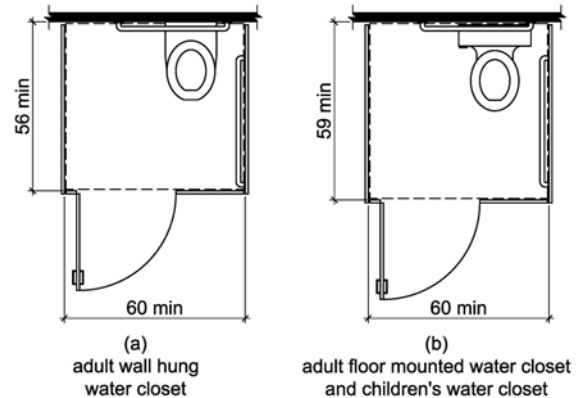


FIGURE 604.8.1.1
SIZE OF WHEELCHAIR ACCESSIBLE TOILET COMPARTMENT

604.8.1.2 Doors. Toilet compartment doors, including door hardware, shall comply with Section 404 except that if the approach is to the latch side of the compartment door, clearance between the door side of the compartment and any obstruction shall be 42 inches minimum. Doors shall be located in the front partition or in the side wall or partition farthest from the water closet. Where located in the front partition, the door opening shall be 4 inches maximum from the side wall or partition farthest from the water closet. Where located in the side wall or partition, the door opening shall be 4 inches maximum from the front partition. The door shall be self-closing. A door pull complying with Subsection 404.2.7 shall be placed on both sides of the door near the latch. Toilet compartment doors shall not swing into the minimum required compartment area.

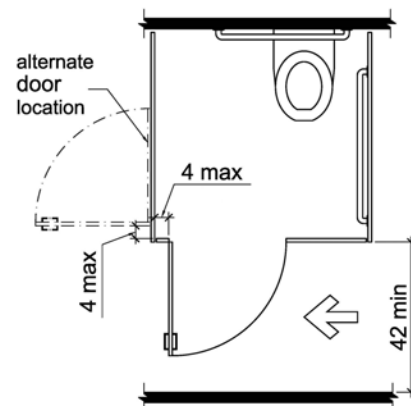


FIGURE 604.8.1.2
WHEELCHAIR ACCESSIBLE TOILET COMPARTMENT DOORS

604.8.1.3 Approach. Compartments shall be arranged for left-hand or right-hand approach to the water closet.

604.8.1.4 Toe clearance. The front partition shall provide a toe clearance of 9 inches minimum above the finish floor and 6 inches deep minimum beyond the compartment-side face of the partition, exclusive of partition support members. Compartments for children's use shall provide a toe clearance of 12 inches minimum above the finish floor.

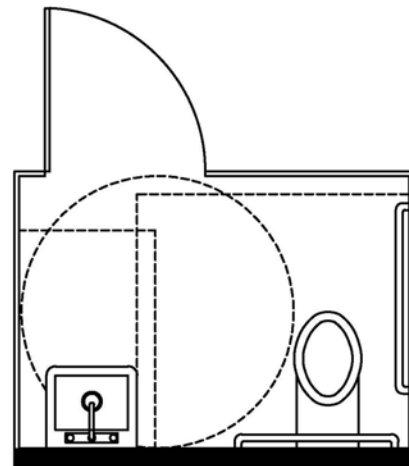
Exception: Toe clearance at the front partition is not required in a compartment greater than 62 inches deep with a wall-hung water closet or 65 inches deep with a floor-mounted water closet. Toe clearance at the side partition is not required in a compartment greater than 66 inches wide. Toe clearance at the front partition is not required in a compartment for children's use that is greater than 65 inches deep.

604.8.1.5 Grab bars. Grab bars shall comply with Section 609. A side-wall grab bar complying with Subsection 604.5.1 shall be provided and shall be located on the wall closest to the water closet. In addition, a rear-wall grab bar complying with Subsection 604.5.2 shall be provided.

604.8.1.6 Lavatory. In new construction, the wheelchair accessible toilet compartment shall contain an accessible lavatory within it, which must be at least 19 inches wide by 17 inches deep, nominal size, and wall-mounted. The lavatory shall be mounted so as not to overlap the clear floor space areas required by this Section for the wheelchair accessible toilet compartment and shall comply with Section 606. Such lavatories shall be counted as part of the required fixture count for the building. See also Subsection 213.3.4.

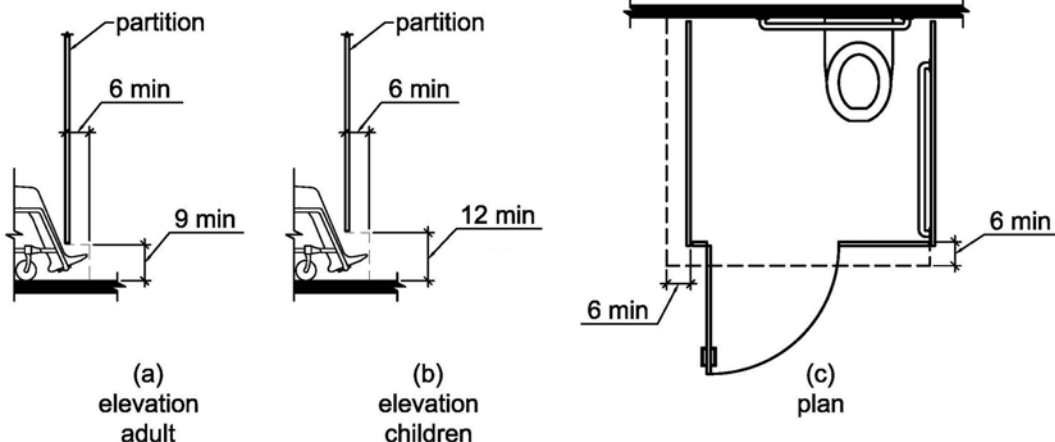
604.8.1.7 Water closet. In new construction, the accessible water closet within the wheelchair accessible compartment shall be located in the corner, diagonal to the door.

Advisory 604.8.1.6 Lavatory and 604.8.1.7 Water closet. Florida law, Section 553.504(5), F.S., stipulates that "...required bathing rooms and toilet rooms in new construction shall be designed and constructed..." with an accessible lavatory in the wheelchair accessible compartment and the water closet located in a corner diagonal to the door. The *ADA Standards for Accessible Design* and therefore this Code require wheelchair accessible compartments in new construction and in alterations of existing buildings to have self closing doors. While the Florida lavatory requirement and water closet placement apply only to new construction, they are desirable for all wheelchair accessible compartments and should be considered where feasible.



Note: The drawings are not the complete code requirements, do not depict all possible options and the code text must be reviewed for additional requirements.

**FIGURE 604.8.1.6
WHEELCHAIR ACCESSIBLE TOILET
COMPARTMENT IN NEW CONSTRUCTION**



**FIGURE 604.8.1.4
WHEELCHAIR ACCESSIBLE TOILET COMPARTMENT TOE CLEARANCE**

604.8.2 Ambulatory accessible compartments. Ambulatory accessible compartments shall comply with this Subsection.

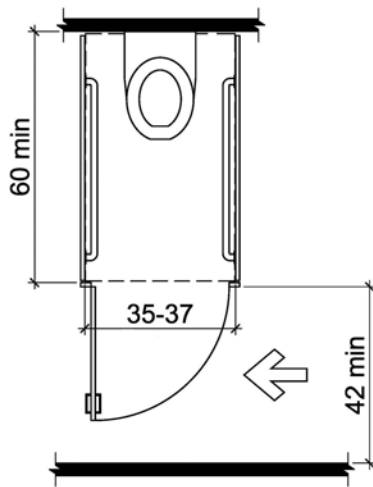


FIGURE 604.8.2
AMBULATORY ACCESSIBLE TOILET COMPARTMENT

604.8.2.1 Size. Ambulatory accessible compartments shall have a depth of 60 inches minimum and a width of 35 inches minimum and 37 inches maximum.

604.8.2.2 Doors. Toilet compartment doors, including door hardware, shall comply with Section 404, except that if the approach is to the latch side of the compartment door, clearance between the door side of the compartment and any obstruction shall be 42 inches minimum. The door shall be self-closing. A door pull complying with Subsection 404.2.7 shall be placed on both sides of the door near the latch. Toilet compartment doors shall not swing into the minimum required compartment area.

604.8.2.3 Grab Bars. Grab bars shall comply with Section 609. A side-wall grab bar complying with Subsection 604.5.1 shall be provided on both sides of the compartment.

604.8.3 Coat hooks and shelves. Coat hooks shall be located within one of the reach ranges specified in Section 308. Shelves shall be located 40 inches minimum and 48 inches maximum above the finish floor.

604.9 Water closets and toilet compartments for children's use. Water closets and toilet compartments for children's use shall comply with this Subsection.

Advisory 604.9 Water closets and toilet compartments for children's use. The requirements in this Subsection are to be followed where the exception for children's water closets in Subsection 604.1 is used. The following table provides additional guidance in applying the specifications for water closets for children according to the age group served and reflects the differences in the size, stature, and reach ranges of children ages three through 12. The specifications chosen should correspond to the age of the primary user group. The specifications of one age group should be applied consistently in the installation of a water closet and related elements.

604.9.1 Location. The water closet shall be located with a wall or partition to the rear and to one side. The centerline of the water closet shall be 12 inches minimum and 18 inches maximum from the side wall or partition, except that the water closet shall be 17 inches minimum and 19 inches maximum from the side wall or partition in the ambulatory accessible toilet compartment specified in Subsection 604.8.2. Compartments shall be arranged for left-hand or right-hand approach to the water closet.

604.9.2 Clearance. Clearance around a water closet shall comply with Subsection 604.3.

604.9.3 Height. The height of water closets shall be 11 inches minimum and 17 inches maximum measured to the top of the seat. Seats shall not be sprung to return to a lifted position.

604.9.4 Grab Bars. Grab bars for water closets shall comply with Subsection 604.5.

604.9.5 Flush controls. Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with Subsections 309.2 and 309.4 and shall be installed 36 inches maximum above the finish floor. Flush controls shall be located on the open side of the water closet except in ambulatory accessible compartments complying with Subsection 604.8.2.

604.9.6 Dispensers. Toilet paper dispensers shall comply with Subsection 309.4 and shall be 7 inches minimum and 9 inches maximum in front of the water closet measured to the centerline of the dispenser. The outlet of the dispenser

TABLE 604.9
ADVISORY SPECIFICATIONS FOR WATER CLOSETS SERVING CHILDREN AGES 3 THROUGH 12

	Ages 3 and 4	Ages 5 through 8	Ages 9 through 12
Water Closet Centerline	12 inches	12 to 15 inches	15 to 18 inches
Toilet Seat Height	11 to 12 inches	12 to 15 inches	15 to 17 inches
Grab Bar Height	18 to 20 inches	20 to 25 inches	25 to 27 inches
Dispenser Height	14 inches	14 to 17 inches	17 to 19 inches

shall be 14 inches minimum and 19 inches maximum above the finish floor. There shall be a clearance of 1½ inches minimum below the grab bar. Dispensers shall not be of a type that controls delivery or that does not allow continuous paper flow.

604.9.7 Toilet compartments. Toilet compartments shall comply with Subsection 604.8.

SECTION 605 URINALS

605.1 General. Urinals shall comply with this Section.

Advisory 605.1 General. Stall-type urinals provide greater accessibility for a broader range of persons, including people of short stature.

605.2 Height and depth. Urinals shall be the stall-type or the wall-hung type with the rim 17 inches maximum above the finish floor or ground. Urinals shall be 13½ inches deep minimum measured from the outer face of the urinal rim to the back of the fixture.

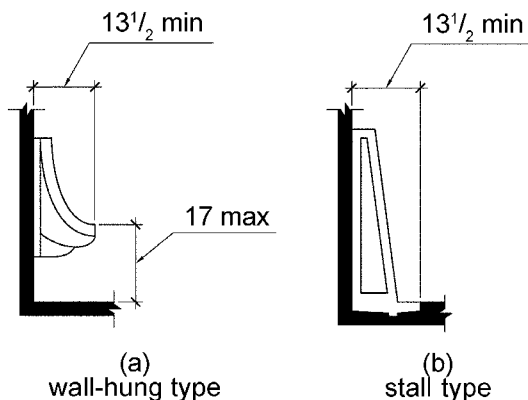


FIGURE 605.2
HEIGHT AND DEPTH OF URINALS

605.3 Clear floor space. A clear floor or ground space complying with Section 305 positioned for forward approach shall be provided.

605.4 Flush controls. Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with Section 309.

SECTION 606 LAVATORIES AND SINKS

606.1 General. Lavatories and sinks shall comply with this Section.

Advisory 606.1 General. If soap and towel dispensers are provided, they must be located within the reach ranges specified in Section 308. Locate soap and towel dispensers so that they are conveniently usable by a person at the accessible lavatory.

606.2 Clear floor space. A clear floor space complying with Section 305, positioned for a forward approach, and knee and toe clearance complying with Section 306 shall be provided.

Exceptions:

1. A parallel approach complying with Section 305 shall be permitted to a kitchen sink, in a space where a cook top or conventional range is not provided, and to wet bars.
2. A lavatory in a toilet room or bathing facility for a single occupant accessed only through a private office and not for common use or public use shall not be required to provide knee and toe clearance complying with Section 306.
3. In residential dwelling units, cabinetry shall be permitted under lavatories and kitchen sinks provided that all of the following conditions are met:
 - (a) the cabinetry can be removed without removal or replacement of the fixture;
 - (b) the finish floor extends under the cabinetry; and
 - (c) the walls behind and surrounding the cabinetry are finished.
4. A knee clearance of 24 inches minimum above the finish floor or ground shall be permitted at lavatories and sinks used primarily by children six through 12 years where the rim or counter surface is 31 inches maximum above the finish floor or ground.
5. A parallel approach complying with Section 305 shall be permitted to lavatories and sinks used primarily by children five years and younger.
6. The dip of the overflow shall not be considered in determining knee and toe clearances.
7. No more than one bowl of a multibowl sink shall be required to provide knee and toe clearance complying with Section 306.

606.3 Height. Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface 34 inches maximum above the finish floor or ground.

Exceptions:

1. A lavatory in a toilet or bathing facility for a single occupant accessed only through a private office and not for common use or public use shall not be required to comply with this Subsection.
2. In residential dwelling unit kitchens, sinks that are adjustable to variable heights, 29 inches minimum and 36 inches maximum, shall be permitted where rough-in plumbing permits connections of supply and drain pipes for sinks mounted at the height of 29 inches.

606.4 Faucets. Controls for faucets shall comply with Section 309. Hand-operated metering faucets shall remain open for 10 seconds minimum.

606.5 Exposed pipes and surfaces. Water supply and drain pipes under lavatories and sinks shall be insulated or other-

wise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.

SECTION 607 BATHTUBS

607.1 General. Bathtubs shall comply with this Section.

607.2 Clearance. Clearance in front of bathtubs shall extend the length of the bathtub and shall be 30 inches wide minimum. A lavatory complying with Section 606 shall be permitted at the control end of the clearance. Where a permanent seat is provided at the head end of the bathtub, the clearance shall extend 12 inches minimum beyond the wall at the head end of the bathtub.

607.3 Seat. A permanent seat at the head end of the bathtub or a removable in-tub seat shall be provided. Seats shall comply with Section 610.

607.4 Grab bars. Grab bars for bathtubs shall comply with Section 609 and shall be provided in accordance with Subsection 607.4.1 or 607.4.2.

Exceptions:

1. Grab bars shall not be required to be installed in a bathtub located in a bathing facility for a single occupant accessed only through a private office and not for common use or public use provided that rein-

forcement has been installed in walls and located so as to permit the installation of grab bars complying with this Subsection.

2. In residential dwelling units, grab bars shall not be required to be installed in bathtubs located in bathing facilities provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with this Subsection.

607.4.1 Bathtubs with permanent seats. For bathtubs with permanent seats, grab bars shall be provided in accordance with this Subsection.

607.4.1.1 Back wall. Two grab bars shall be installed on the back wall, one located in accordance with Subsection 609.4 and the other located 8 inches minimum and 10 inches maximum above the rim of the bathtub. Each grab bar shall be installed 15 inches maximum from the head end wall and 12 inches maximum from the control end wall.

607.4.1.2 Control end wall. A grab bar 24 inches long minimum shall be installed on the control end wall at the front edge of the bathtub.

607.4.2 Bathtubs without permanent seats. For bathtubs without permanent seats, grab bars shall comply with this Subsection.

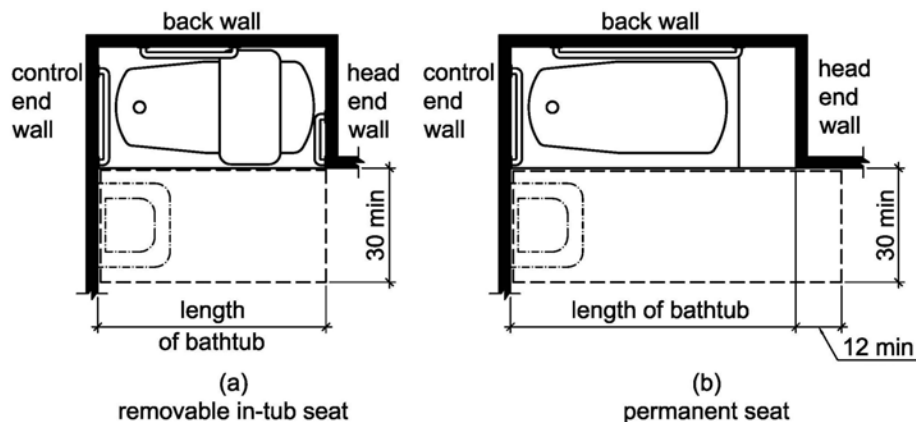


FIGURE 607.2
CLEARANCE FOR BATHTUBS

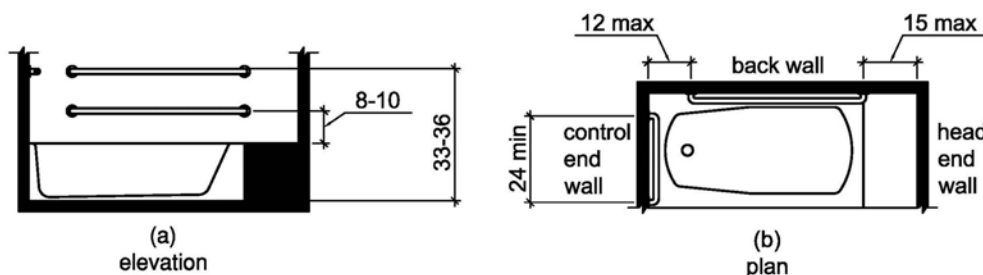


FIGURE 607.4.1
GRAB BARS FOR BATHTUBS WITH PERMANENT SEATS

607.4.2.1 Back wall. Two grab bars shall be installed on the back wall, one located in accordance with Subsection 609.4 and the other located 8 inches minimum and 10 inches maximum above the rim of the bathtub. Each grab bar shall be 24 inches long minimum and shall be installed 24 inches maximum from the head end wall and 12 inches maximum from the control end wall.

607.4.2.2 Control end wall. A grab bar 24 inches long minimum shall be installed on the control end wall at the front edge of the bathtub.

607.4.2.3 Head end wall. A grab bar 12 inches long minimum shall be installed on the head end wall at the front edge of the bathtub.

607.5 Controls. Controls, other than drain stoppers, shall be located on an end wall. Controls shall be between the bathtub rim and grab bar, and between the open side of the bathtub and the centerline of the width of the bathtub. Controls shall comply with Section 309.4.

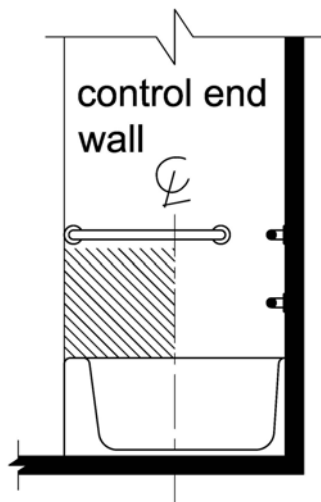


FIGURE 607.5
BATHTUB CONTROL LOCATION

607.6 Shower spray unit and water. A shower spray unit with a hose 59 inches long minimum that can be used both as a fixed-position shower head and as a hand-held shower shall be provided. The shower spray unit shall have an on/off control with a nonpositive shut-off. If an adjustable-height shower head on a vertical bar is used, the bar shall be installed so as not to obstruct the use of grab bars. Bathtub shower spray units shall deliver water that is 120°F maximum.

Advisory 607.6 Shower spray unit and water. Ensure that hand-held shower spray units are capable of delivering water pressure substantially equivalent to fixed shower heads.

607.7 Bathtub enclosures. Enclosures for bathtubs shall not obstruct controls, faucets, shower and spray units or obstruct transfer from wheelchairs onto bathtub seats or into bathtubs. Enclosures on bathtubs shall not have tracks installed on the rim of the open face of the bathtub.

SECTION 608 SHOWER COMPARTMENTS

608.1 General. Shower compartments shall comply with this Section.

Advisory 608.1 General. Shower stalls that are 60 inches wide and have no curb may increase the usability of a bathroom because the shower area provides additional maneuvering space.

608.2 Size and clearances for shower compartments. Shower compartments shall have sizes and clearances complying with this Subsection.

608.2.1 Transfer type shower compartments. Transfer type shower compartments shall be 36 inches by 36 inches clear inside dimensions measured at the center points of opposing sides and shall have a 36 inch wide minimum entry on the face of the shower compartment. Clearance of 36 inches wide minimum by 48 inches long minimum measured from the control wall shall be provided.

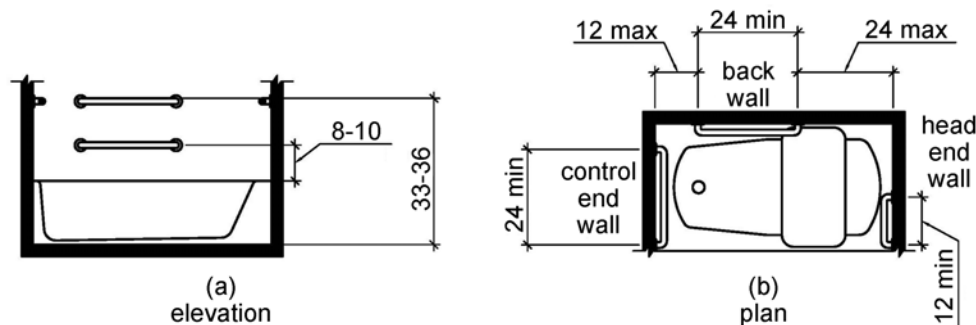


FIGURE 607.4.2
GRAB BARS FOR BATHTUBS WITH REMOVABLE IN-TUB SEATS

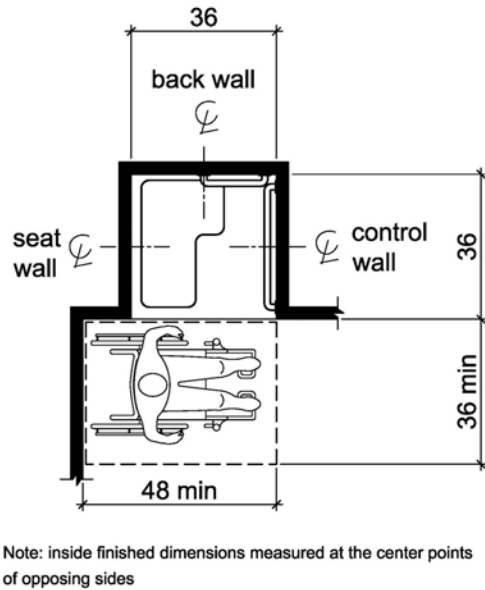


FIGURE 608.2.1
TRANSFER TYPE SHOWER
COMPARTMENT SIZE AND CLEARANCE

608.2.2 Standard roll-in type shower compartments. Standard roll-in type shower compartments shall be 30 inches wide minimum by 60 inches deep minimum clear inside dimensions measured at center points of opposing sides and shall have a 60 inches wide minimum entry on the face of the shower compartment.

608.2.2.1 Clearance. A 30 inch wide minimum by 60 inch long minimum clearance shall be provided adjacent to the open face of the shower compartment.

Exception: A lavatory complying with Section 606 shall be permitted on one 30 inch wide minimum side of the clearance provided that it is not on the side of the clearance adjacent to the controls or, where provided, not on the side of the clearance adjacent to the shower seat.

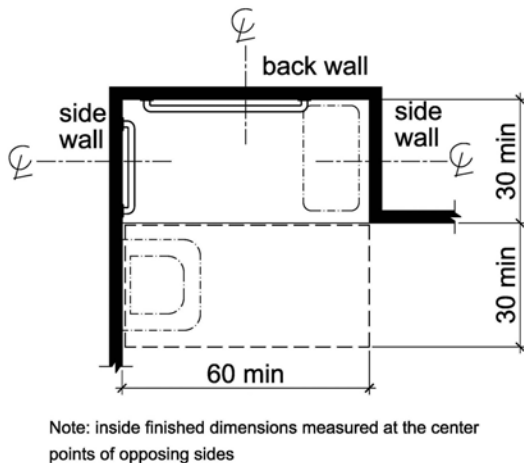


FIGURE 608.2.2
STANDARD ROLL-IN TYPE SHOWER
COMPARTMENT SIZE AND CLEARANCE

608.2.3 Alternate roll-in type shower compartments.

Alternate roll-in type shower compartments shall be 36 inches wide and 60 inches deep minimum clear inside dimensions measured at center points of opposing sides. A 36 inch wide minimum entry shall be provided at one end of the long side of the compartment.

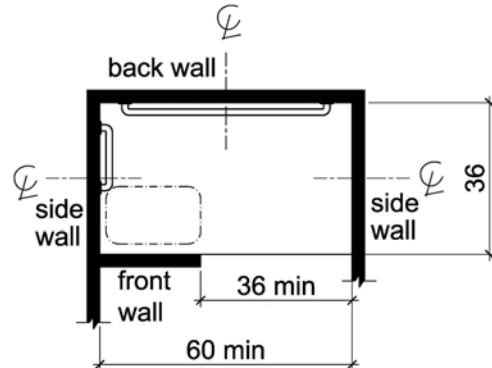


FIGURE 608.2.3
ALTERNATE ROLL-IN TYPE SHOWER
COMPARTMENT SIZE AND CLEARANCE

608.3 Grab bars. Grab bars shall comply with Section 609 and shall be provided in accordance with this Subsection. Where multiple grab bars are used, required horizontal grab bars shall be installed at the same height above the finish floor.

Exceptions:

1. Grab bars shall not be required to be installed in a shower located in a bathing facility for a single occupant accessed only through a private office, and not for common use or public use provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with this Subsection.
2. In residential dwelling units, grab bars shall not be required to be installed in showers located in bathing facilities provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with this Subsection.

608.3.1 Transfer type shower compartments. In transfer type compartments, grab bars shall be provided across the control wall and back wall to a point 18 inches from the control wall.

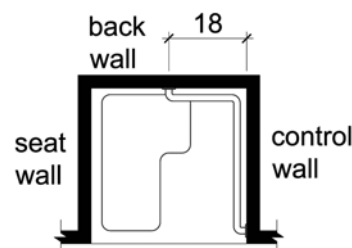


FIGURE 608.3.1
GRAB BARS FOR TRANSFER TYPE SHOWERS

608.3.2 Standard roll-in type shower compartments.

Where a seat is provided in standard roll-in type shower compartments, grab bars shall be provided on the back wall and the side wall opposite the seat. Grab bars shall not be provided above the seat. Where a seat is not provided in standard roll-in type shower compartments, grab bars shall be provided on three walls. Grab bars shall be installed 6 inches maximum from adjacent walls.

608.3.3 Alternate roll-in type shower compartments.

In alternate roll-in type shower compartments, grab bars shall be provided on the back wall and the side wall farthest from the compartment entry. Grab bars shall not be provided above the seat. Grab bars shall be installed 6 inches (1 maximum from adjacent walls).

608.4 Seats. A folding or nonfolding seat shall be provided in transfer type shower compartments. A folding seat shall be provided in roll-in type showers required in transient lodging guestrooms with mobility features complying with Subsection 806.2. Seats shall comply with Section 610.

Exception: In residential dwelling units, seats shall not be required in transfer type shower compartments provided that reinforcement has been installed in walls so as to permit the installation of seats complying with this Subsection.

608.5 Controls. Controls, faucets, and shower spray units shall comply with Subsection 309.4.

608.5.1 Transfer type shower compartments. In transfer type shower compartments, the controls, faucets, and shower spray unit shall be installed on the side wall opposite the seat 38 inches minimum and 48 inches maximum above the shower floor and shall be located on the control wall 15 inches maximum from the centerline of the seat toward the shower opening.

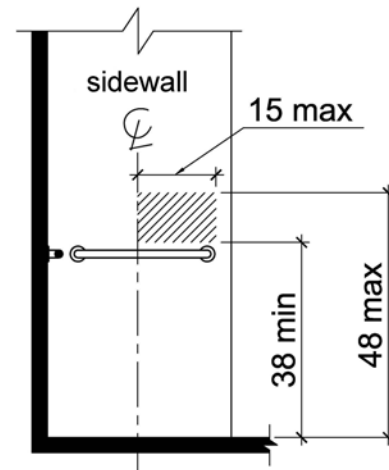


FIGURE 608.5.1
TRANSFER TYPE SHOWER
COMPARTMENT CONTROL LOCATION

608.5.2 Standard roll-in type shower compartments. In standard roll-in type shower compartments, the controls, faucets, and shower spray unit shall be located above the grab bar, but no higher than 48 inches above the shower floor. Where a seat is provided, the controls, faucets, and shower spray unit shall be installed on the back wall adjacent to the seat wall and shall be located 27 inches maximum from the seat wall.

Advisory 608.5.2 Standard roll-in type shower compartments. In standard roll-in type showers without seats, the shower head and operable parts can be located on any of the three walls of the shower without adversely affecting accessibility.

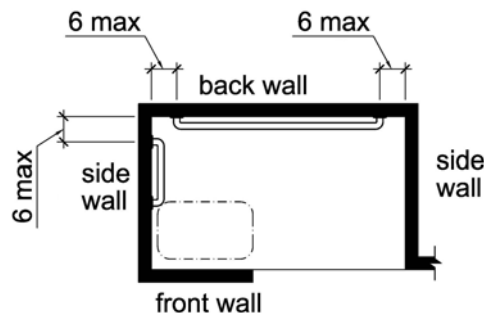


FIGURE 608.3.3
GRAB BARS FOR ALTERNATE ROLL-IN TYPE SHOWERS

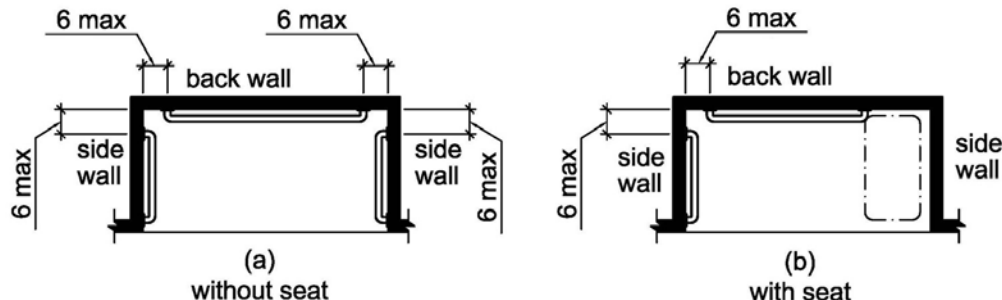


FIGURE 608.3.2
GRAB BARS FOR STANDARD ROLL-IN TYPE SHOWERS

608.5.3 Alternate roll-in type shower compartments. In alternate roll-in type shower compartments, the controls, faucets, and shower spray unit shall be located above the grab bar, but no higher than 48 inches above the shower floor. Where a seat is provided, the controls, faucets, and shower spray unit shall be located on the side wall adjacent to the seat 27 inches maximum from the side wall behind the seat or shall be located on the back wall opposite the seat 15 inches maximum, left or right, of the centerline of the seat. Where a seat is not provided, the controls, faucets, and shower spray unit shall be installed on the side wall farthest from the compartment entry.

608.6 Shower spray unit and water. A shower spray unit with a hose 59 inches long minimum that can be used both as a fixed-position shower head and as a hand-held shower shall

be provided. The shower spray unit shall have an on/off control with a nonpositive shut-off. If an adjustable-height shower head on a vertical bar is used, the bar shall be installed so as not to obstruct the use of grab bars. Shower spray units shall deliver water that is 120°F maximum.

Exception: A fixed shower head located at 48 inches maximum above the shower finish floor shall be permitted instead of a hand-held spray unit in facilities that are not medical care facilities, long-term care facilities, transient lodging guestrooms, or residential dwelling units.

Advisory 608.6 Shower spray unit and water. Ensure that hand-held shower spray units are capable of delivering water pressure substantially equivalent to fixed shower heads.

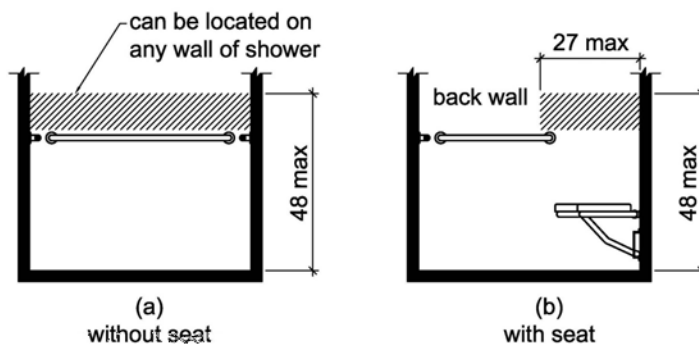


FIGURE 608.5.2
STANDARD ROLL-IN TYPE SHOWER COMPARTMENT CONTROL LOCATION

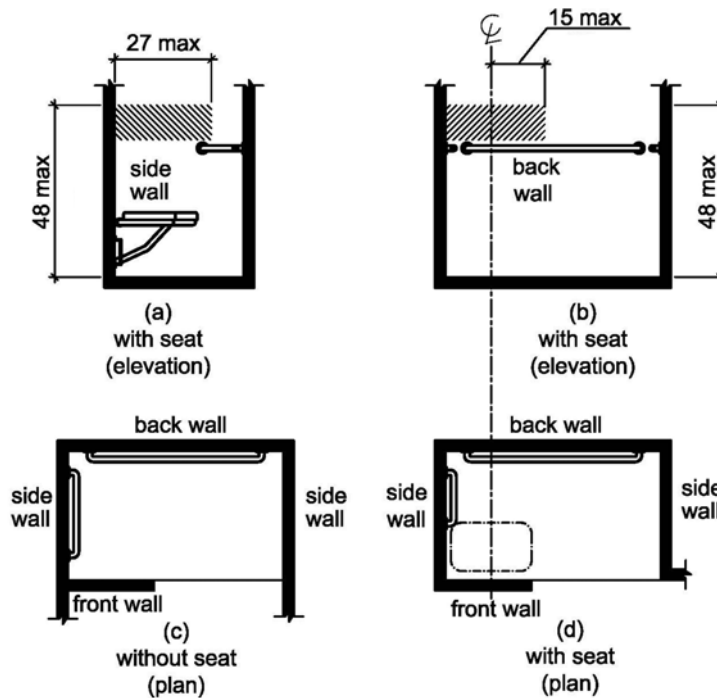


FIGURE 608.5.3
ALTERNATE ROLL-IN TYPE SHOWER COMPARTMENT CONTROL LOCATION

608.7 Thresholds. Thresholds in roll-in type shower compartments shall be $\frac{1}{2}$ inch high maximum in accordance with Section 303. In transfer type shower compartments, thresholds $\frac{1}{2}$ inch high maximum shall be beveled, rounded, or vertical.

Exception: A threshold 2 inches high maximum shall be permitted in transfer type shower compartments in existing facilities where provision of a $\frac{1}{2}$ inch high threshold would disturb the structural reinforcement of the floor slab.

608.8 Shower enclosures. Enclosures for shower compartments shall not obstruct controls, faucets, and shower spray units or obstruct transfer from wheelchairs onto shower seats.

SECTION 609 GRAB BARS

609.1 General. Grab bars in toilet facilities and bathing facilities shall comply with this Section.

609.2 Cross section. Grab bars shall have a cross section complying with Subsection 609.2.1 or 609.2.2.

609.2.1 Circular cross section. Grab bars with circular cross sections shall have an outside diameter of $1\frac{1}{4}$ inches minimum and 2 inches maximum.

609.2.2 Noncircular cross section. Grab bars with noncircular cross sections shall have a cross-section dimension of 2 inches maximum and a perimeter dimension of 4 inches minimum and 4.8 inches maximum.

609.3 Spacing. The space between the wall and the grab bar shall be $1\frac{1}{2}$ inches. The space between the grab bar and projecting objects below and at the ends shall be $1\frac{1}{2}$ inches minimum. The space between the grab bar and projecting objects above shall be 12 inches minimum.

Exception: The space between the grab bars and shower controls, shower fittings, and other grab bars above shall be permitted to be $1\frac{1}{2}$ inches minimum.

609.4 Position of grab bars. Grab bars shall be installed in a horizontal position, 33 inches minimum and 36 inches maximum above the finish floor measured to the top of the gripping surface, except that at water closets for children's use complying with Subsection 604.9, grab bars shall be installed

in a horizontal position 18 inches minimum and 27 inches maximum above the finish floor measured to the top of the gripping surface. The height of the lower grab bar on the back wall of a bathtub shall comply with Subsection 607.4.1.1 or 607.4.2.1.

609.5 Surface hazards. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges.

609.6 Fittings. Grab bars shall not rotate within their fittings.

609.7 Installation. Grab bars shall be installed in any manner that provides a gripping surface at the specified locations and that does not obstruct the required clear floor space.

609.8 Structural strength. Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds is applied at any point on the grab bar, fastener, mounting device, or supporting structure.

SECTION 610 SEATS

610.1 General. Seats in bathtubs and shower compartments shall comply with this Section.

610.2 Bathtub seats. The top of bathtub seats shall be 17 inches minimum and 19 inches maximum above the bathroom finish floor. The depth of a removable in-tub seat shall be 15 inches minimum and 16 inches maximum. The seat shall be capable of secure placement. Permanent seats at the head end of the bathtub shall be 15 inches deep minimum and shall extend from the back wall to or beyond the outer edge of the bathtub.

610.3 Shower compartment seats. Where a seat is provided in a standard roll-in shower compartment, it shall be a folding type, shall be installed on the side wall adjacent to the controls, and shall extend from the back wall to a point within 3 inches of the compartment entry. Where a seat is provided in an alternate roll-in type shower compartment, it shall be a folding type, shall be installed on the front wall opposite the back wall, and shall extend from the adjacent side wall to a point within 3 inches of the compartment entry. In transfer-type showers, the seat shall extend from the back wall to a

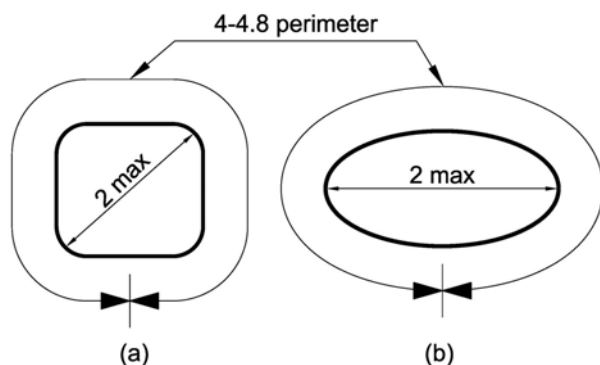


FIGURE 609.2.2
GRAB BAR NONCIRCULAR CROSS SECTION

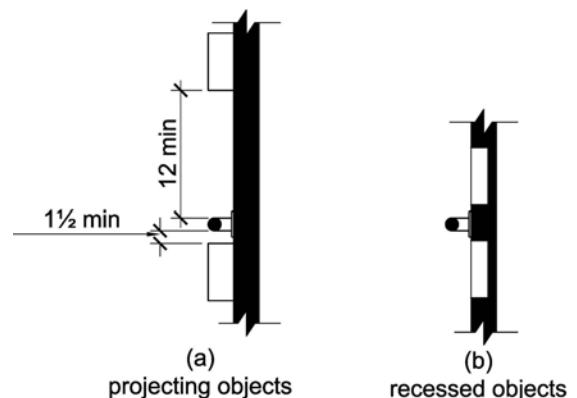


FIGURE 609.3
SPACING OF GRAB BARS

point within 3 inches of the compartment entry. The top of the seat shall be 17 inches minimum and 19 inches maximum above the bathroom finish floor. Seats shall comply with Sub-section 610.3.1 or 610.3.2.

610.3.1 Rectangular seats. The rear edge of a rectangular seat shall be $2\frac{1}{2}$ inches maximum and the front edge 15 inches minimum and 16 inches maximum from the seat

wall. The side edge of the seat shall be $1\frac{1}{2}$ inches maximum from the adjacent wall.

610.3.2 L-Shaped Seats. The rear edge of an L-shaped seat shall be $2\frac{1}{2}$ inches maximum and the front edge 15 inches minimum and 16 inches maximum from the seat wall. The rear edge of the “L” portion of the seat shall be $1\frac{1}{2}$ inches maximum from the wall and the front edge shall

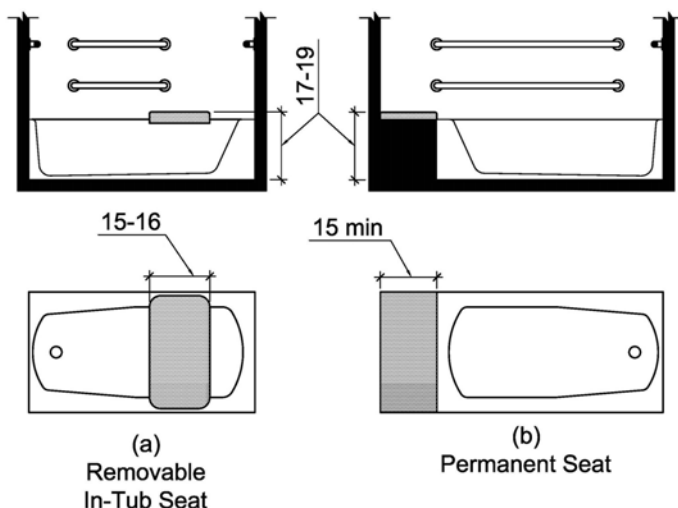


FIGURE 610.2
BATHTUB SEATS

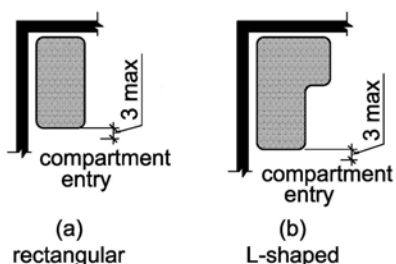


FIGURE 610.3
EXTENT OF SEAT

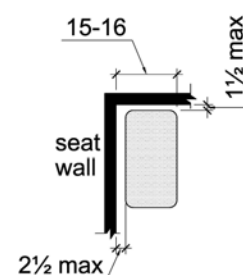


FIGURE 610.3.1
RECTANGULAR SHOWER SEAT

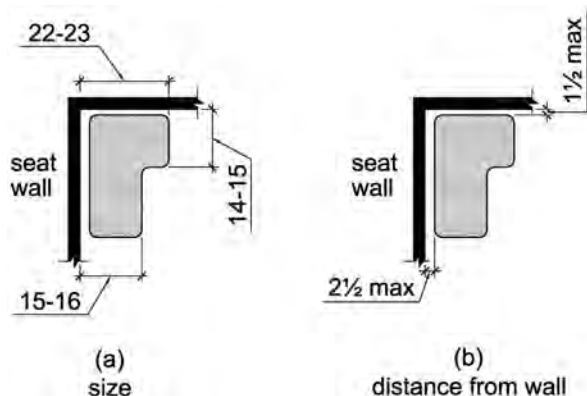


FIGURE 610.3.2
L-SHAPED SHOWER SEAT

be 14 inches minimum and 15 inches maximum from the wall. The end of the "L" shall be 22 inches minimum and 23 inches maximum from the main seat wall.

610.4 Structural strength. Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds is applied at any point on the seat, fastener, mounting device, or supporting structure.

SECTION 611 WASHING MACHINES AND CLOTHES DRYERS

611.1 General. Washing machines and clothes dryers shall comply with this Section.

611.2 Clear floor space. A clear floor or ground space complying with Section 305 positioned for parallel approach shall be provided. The clear floor or ground space shall be centered on the appliance.

611.3 Operable parts. Operable parts, including doors, lint screens, and detergent and bleach compartments shall comply with Section 309.

611.4 Height. Top loading machines shall have the door to the laundry compartment located 36 inches maximum above the finish floor. Front loading machines shall have the bottom of the opening to the laundry compartment located 15 inches minimum and 36 inches maximum above the finish floor.

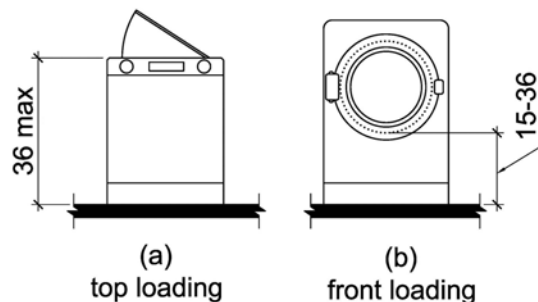


FIGURE 611.4
HEIGHT OF LAUNDRY COMPARTMENT OPENING

SECTION 612 SAUNAS AND STEAM ROOMS

612.1 General. Saunas and steam rooms shall comply with this Section.

612.2 Bench. Where seating is provided in saunas and steam rooms, at least one bench shall comply with Section 903. Doors shall not swing into the clear floor space required by Subsection 903.2.

Exception: A readily removable bench shall be permitted to obstruct the turning space required by Subsection 612.3 and the clear floor or ground space required by Subsection 903.2.

612.3 Turning space. A turning space complying with Section 304 shall be provided within saunas and steam rooms.

CHAPTER 7

COMMUNICATION ELEMENTS AND FEATURES

SECTION 701 GENERAL

701.1 Scope. The provisions of this Chapter shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

SECTION 702 FIRE ALARM SYSTEMS

702.1 General. Fire alarm systems shall have permanently installed audible and visible alarms complying with NFPA 72 (1999 or 2002 edition) (incorporated by reference, see “Referenced Standards” in Chapter 1), except that the maximum allowable sound level of audible notification appliances complying with Section 4-3.2.1 of NFPA 72 (1999 edition) shall have a sound level no more than 110 dB at the minimum hearing distance from the audible appliance. In addition, alarms in guestrooms required to provide communication features shall comply with Sections 4-3 and 4-4 of NFPA 72 (1999 edition) or Sections 7.4 and 7.5 of NFPA 72 (2002 edition).

Exception: Fire alarm systems in medical care facilities shall be permitted to be provided in accordance with industry practice.

SECTION 703 SIGNS

703.1 General. Signs shall comply with this Section. Where both visual and tactile characters are required, either one sign with both visual and tactile characters, or two separate signs, one with visual, and one with tactile characters, shall be provided.

703.2 Raised characters. Raised characters shall comply with this Subsection and shall be duplicated in braille complying with Subsection 703.3. Raised characters shall be installed in accordance with Subsection 703.4.

Advisory 703.2 Raised characters. Signs that are designed to be read by touch should not have sharp or abrasive edges.

703.2.1 Depth. Raised characters shall be $\frac{1}{32}$ inch minimum above their background.

703.2.2 Case. Characters shall be uppercase.

703.2.3 Style. Characters shall be sans serif. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms.

703.2.4 Character proportions. Characters shall be selected from fonts where the width of the uppercase letter “O” is 55 percent minimum and 110 percent maximum of the height of the uppercase letter “I”.

703.2.5 Character height. Character height measured vertically from the baseline of the character shall be $\frac{5}{8}$

inch minimum and 2 inches maximum based on the height of the uppercase letter “I”.

Exception: Where separate raised and visual characters with the same information are provided, raised character height shall be permitted to be $\frac{1}{2}$ inch minimum.

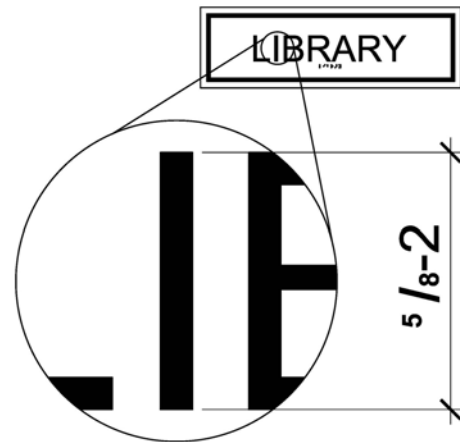


FIGURE 703.2.5
HEIGHT OF RAISED CHARACTERS

703.2.6 Stroke thickness. Stroke thickness of the uppercase letter “I” shall be 15 percent maximum of the height of the character.

703.2.7 Character spacing. Character spacing shall be measured between the two closest points of adjacent raised characters within a message, excluding word spaces. Where characters have rectangular cross sections, spacing between individual raised characters shall be $\frac{1}{8}$ inch minimum and 4 times the raised character stroke width maximum. Where characters have other cross sections, spacing between individual raised characters shall be $\frac{1}{16}$ inch minimum and 4 times the raised character stroke width maximum at the base of the cross sections, and $\frac{1}{8}$ inch minimum and 4 times the raised character stroke width maximum at the top of the cross sections. Characters shall be separated from raised borders and decorative elements $\frac{3}{8}$ inch minimum.

703.2.8 Line spacing. Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.

703.3 Braille. Braille shall be contracted (Grade 2) and shall comply with this Subsection and Subsection 703.4.

703.3.1 Dimensions and capitalization. Braille dots shall have a domed or rounded shape and shall comply with Table 703.3.1. The indication of an uppercase letter or let-

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ters shall only be used before the first word of sentences, proper nouns and names, individual letters of the alphabet, initials, and acronyms.

**TABLE 703.3.1
BRAILLE DIMENSIONS**

MEASUREMENT RANGE	MINIMUM IN INCHES MAXIMUM IN INCHES
Dot base diameter	0.059 to 0.063
Distance between two dots in the same cell ¹	0.090 to 0.100
Distance between corresponding dots in adjacent cells ¹	0.241 to 0.300
Dot height	0.025 to 0.037
Distance between corresponding dots from one cell directly below ¹	0.395 to 0.400

1. Measured center to center.

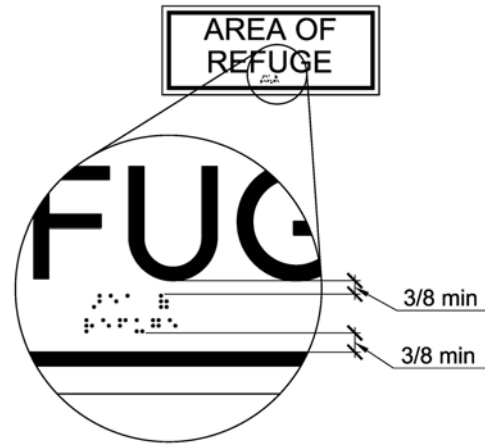
703.3.2 Position. Braille shall be positioned below the corresponding text. If text is multilined, braille shall be placed below the entire text. Braille shall be separated $\frac{3}{8}$ inch minimum from any other tactile characters and $\frac{3}{8}$ inch minimum from raised borders and decorative elements.

Exception: Braille provided on elevator car controls shall be separated $\frac{3}{16}$ inch minimum and shall be located either directly below or adjacent to the corresponding raised characters or symbols.

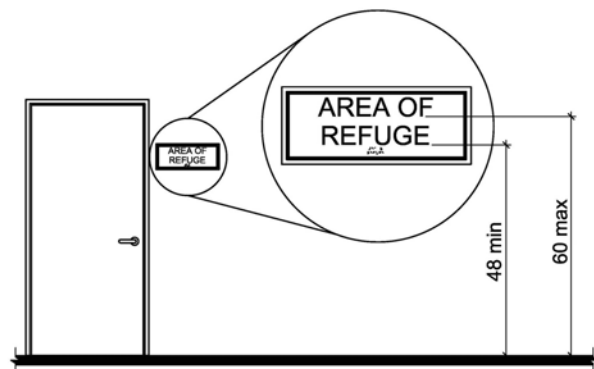
703.4 Installation height and location. Signs with tactile characters shall comply with this Subsection.

703.4.1 Height above finish floor or ground. Tactile characters on signs shall be located 48 inches minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.

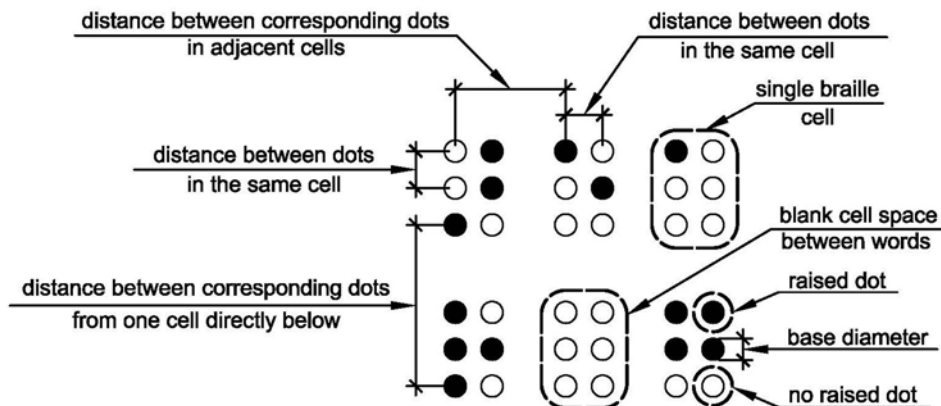
Exception: Tactile characters for elevator car controls shall not be required to comply with this Subsection.



**FIGURE 703.3.2
POSITION OF BRAILLE**



**FIGURE 703.4.1
HEIGHT OF TACTILE CHARACTERS
ABOVE FINISH FLOOR OR GROUND**



**FIGURE 703.3.1
BRAILLE MEASUREMENT**

703.4.2 Location. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leaves, the sign shall be located to the right of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall. Signs containing tactile characters shall be located so that a clear floor space of 18 inches minimum by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.

Exception: Signs with tactile characters shall be permitted on the push side of doors with closers and without hold-open devices.

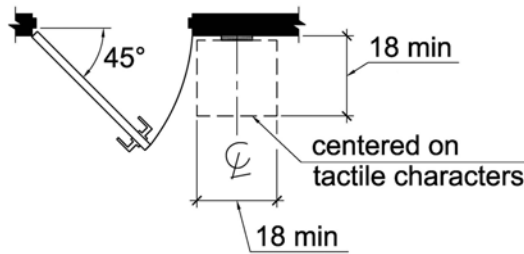


FIGURE 703.4.2
LOCATION OF TACTILE SIGNS AT DOORS

703.5 Visual characters. Visual characters shall comply with this Subsection.

Exception: Where visual characters comply with Subsection 703.2 and are accompanied by braille complying with Subsection 703.3, they shall not be required to comply with Subsections 703.5.2 through 703.5.9.

703.5.1 Finish and contrast. Characters and their background shall have a nonglare finish. Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background.

Advisory 703.5.1 Finish and contrast. Signs are more legible for persons with low vision when characters contrast as much as possible with their background. Additional factors affecting the ease with which the text can be distinguished from its background include shadows cast by lighting sources, surface glare, and the uniformity of the text and its background colors and textures.

703.5.2 Case. Characters shall be uppercase or lowercase or a combination of both.

703.5.3 Style. Characters shall be conventional in form. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms.

703.5.4 Character proportions. Characters shall be selected from fonts where the width of the uppercase letter "O" is 55 percent minimum and 110 percent maximum of the height of the uppercase letter "I".

703.5.5 Character height. Minimum character height shall comply with Table 703.5.5. Viewing distance shall be measured as the horizontal distance between the character and an obstruction preventing further approach towards the sign. Character height shall be based on the uppercase letter "I".

703.5.6 Height from finish floor or ground. Visual characters shall be 40 inches minimum above the finish floor or ground.

Exception: Visual characters indicating elevator car controls shall not be required to comply with this Subsection.

703.5.7 Stroke thickness. Stroke thickness of the uppercase letter "I" shall be 10 percent minimum and 30 percent maximum of the height of the character.

703.5.8 Character spacing. Character spacing shall be measured between the two closest points of adjacent characters, excluding word spaces. Spacing between individual characters shall be 10 percent minimum and 35 percent maximum of character height.

703.5.9 Line Spacing. Spacing between the baselines of separate lines of characters within a message shall be 135

TABLE 703.5.5
VISUAL CHARACTER HEIGHT

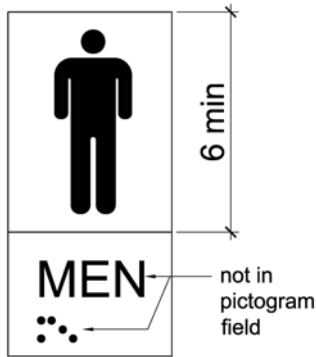
HEIGHT TO FINISH FLOOR OR GROUND FROM BASELINE OF CHARACTER	HORIZONTAL VIEWING DISTANCE	MINIMUM CHARACTER HEIGHT
40 inches to less than or equal to 70 inches	less than 72 inches	$\frac{5}{8}$ inch
	72 inches and greater	$\frac{5}{8}$ inch, plus $\frac{1}{8}$ inch per foot of viewing distance above 72 inches
Greater than 70 inches to less than or equal to 120 inches	less than 180 inches	2 inches
	180 inches and greater	2 inches, plus $\frac{1}{8}$ inch per foot of viewing distance above 180 inches
Greater than 120 inches	less than 21 feet	3 inches
	21 feet and greater	3 inches, plus $\frac{1}{8}$ inch per foot of viewing distance above 21 feet

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percent minimum and 170 percent maximum of the character height.

703.6 Pictograms. Pictograms shall comply with this Subsection.

703.6.1 Pictogram field. Pictograms shall have a field height of 6 inches minimum. Characters and braille shall not be located in the pictogram field.



**FIGURE 703.6.1
PICTOGRAM FIELD**

703.6.2 Finish and contrast. Pictograms and their field shall have a nonglare finish. Pictograms shall contrast with their field with either a light pictogram on a dark field or a dark pictogram on a light field.

Advisory 703.6.2 Finish and contrast. Signs are more legible for persons with low vision when characters contrast as much as possible with their background. Additional factors affecting the ease with which the text can be distinguished from its background include shadows cast by lighting sources, surface glare, and the uniformity of the text and background colors and textures.

703.6.3 Text descriptors. Pictograms shall have text descriptors located directly below the pictogram field. Text descriptors shall comply with Subsections 703.2, 703.3 and 703.4.

703.7 Symbols of accessibility. Symbols of accessibility shall comply with this Subsection.

703.7.1 Finish and contrast. Symbols of accessibility and their background shall have a nonglare finish. Symbols of accessibility shall contrast with their background with either a light symbol on a dark background or a dark symbol on a light background.

Advisory 703.7.1 Finish and contrast. Signs are more legible for persons with low vision when characters contrast as much as possible with their background. Additional factors affecting the ease with which the text can be distinguished from its background include shadows cast by lighting sources, surface glare, and the uniformity of the text and background colors and textures.

703.7.2 Symbols.

703.7.2.1 International symbol of accessibility. The International Symbol of Accessibility shall comply with Figure 703.7.2.1.



**FIGURE 703.7.2.1
INTERNATIONAL SYMBOL OF ACCESSIBILITY**

703.7.2.2 International symbol of TTY. The International Symbol of TTY shall comply with Figure 703.7.2.2.



**FIGURE 703.7.2.2
INTERNATIONAL SYMBOL OF TTY**

703.7.2.3 Volume control telephones. Telephones with a volume control shall be identified by a pictogram of a telephone handset with radiating sound waves on a square field such as shown in Figure 703.7.2.3.



**FIGURE 703.7.2.3
VOLUME CONTROL TELEPHONE**

703.7.2.4 Assistive listening systems. Assistive listening systems shall be identified by the International Symbol of Access for Hearing Loss complying with Figure 703.7.2.4.



FIGURE 703.7.2.4
INTERNATIONAL SYMBOL OF ACCESS FOR HEARING LOSS

SECTION 704 TELEPHONES

704.1 General. Public telephones shall comply with this Section.

704.2 Wheelchair accessible telephones. Wheelchair accessible telephones shall comply with this Subsection.

704.2.1 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided. The clear floor or ground space shall not be obstructed by bases, enclosures, or seats.

Advisory 704.2.1 Clear floor or ground space. Because clear floor and ground space is required to be unobstructed, telephones, enclosures and related telephone book storage cannot encroach on the required clear floor or ground space and must comply with the provisions for protruding objects. (See Section 307).

704.2.1.1 Parallel approach. Where a parallel approach is provided, the distance from the edge of the telephone enclosure to the face of the telephone unit shall be 10 inches maximum.

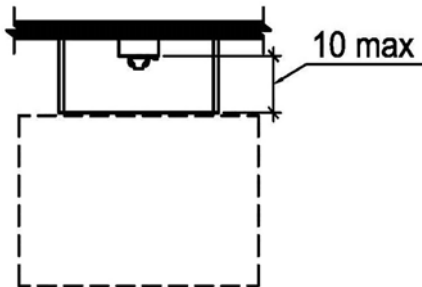


FIGURE 704.2.1.1
PARALLEL APPROACH TO TELEPHONE

704.2.1.2 Forward approach. Where a forward approach is provided, the distance from the front edge of a counter within the telephone enclosure to the face of the telephone unit shall be 20 inches maximum.

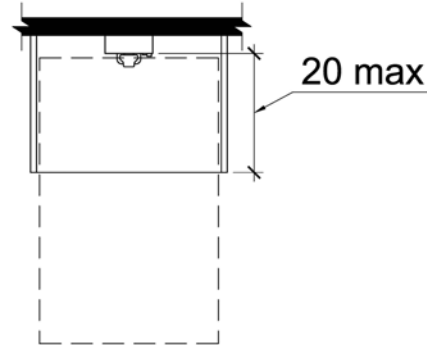


FIGURE 704.2.1.2
FORWARD APPROACH TO TELEPHONE

704.2.2 Operable parts. Operable parts shall comply with Section 309. Telephones shall have push-button controls where such service is available.

704.2.3 Telephone directories. Telephone directories, where provided, shall be located in accordance with Section 309.

704.2.4 Cord length. The cord from the telephone to the handset shall be 29 inches long minimum.

704.3 Volume control telephones. Public telephones required to have volume controls shall be equipped with a receive volume control that provides a gain adjustable up to 20 dB minimum. For incremental volume control, provide at least one intermediate step of 12 dB of gain minimum. An automatic reset shall be provided.

Advisory 704.3 Volume control telephones. Amplifiers on pay phones are located in the base or the handset or are built into the telephone. Most are operated by pressing a button or key. If the microphone in the handset is not being used, a mute button that temporarily turns off the microphone can also reduce the amount of background noise which the person hears in the earpiece. If a volume adjustment is provided that allows the user to set the level anywhere from the base volume to the upper requirement of 20 dB, there is no need to specify a lower limit. If a stepped volume control is provided, one of the intermediate levels must provide 12 dB of gain. Consider compatibility issues when matching an amplified handset with a phone or phone system. Amplified handsets that can be switched with pay telephone handsets are available. Portable and in-line amplifiers can be used with some phones but are not practical at most public phones covered by these requirements.

704.4 TTYs. TTYs required at a public pay telephone shall be permanently affixed within, or adjacent to, the telephone

enclosure. Where an acoustic coupler is used, the telephone cord shall be sufficiently long to allow connection of the TTY and the telephone receiver.

Advisory 704.4 TTYs. Ensure that sufficient electrical service is available where TTYs are to be installed.

704.4.1 Height. When in use, the touch surface of TTY keypads shall be 34 inches minimum above the finish floor.

Exception: Where seats are provided, TTYs shall not be required to comply with this Subsection.

Advisory 704.4.1 Height. A telephone with a TTY installed underneath cannot also be a wheelchair accessible telephone because the required 34 inches minimum keypad height can cause the highest operable part of the telephone, usually the coin slot, to exceed the maximum permitted side and forward reach ranges. (See Section 308).

Advisory 704.4.1 Height exception. While seats are not required at TTYs, reading and typing at a TTY is more suited to sitting than standing. Facilities that often provide seats at TTY's include, but are not limited to, airports and other passenger terminals or stations, courts, art galleries, and convention centers.

704.5 TTY Shelf. Public pay telephones required to accommodate portable TTYs shall be equipped with a shelf and an electrical outlet within or adjacent to the telephone enclosure. The telephone handset shall be capable of being placed flush on the surface of the shelf. The shelf shall be capable of accommodating a TTY and shall have 6 inches minimum vertical clearance above the area where the TTY is to be placed.

SECTION 705 DETECTABLE WARNINGS

705.1 General. Detectable warnings shall consist of a surface of truncated domes and shall comply with this Section.

705.1.1 Dome Size. Truncated domes in a detectable warning surface shall have a base diameter of 0.9 inch minimum and 1.4 inches maximum, a top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and a height of 0.2 inch.

percent of the base diameter minimum to 65 percent of the base diameter maximum, and a height of 0.2 inch.

705.1.2 Dome spacing. Truncated domes in a detectable warning surface shall have a center-to-center spacing of 1.6 inches minimum and 2.4 inches maximum, and a base-to-base spacing of 0.65 inch minimum, measured between the most adjacent domes on a square grid.

705.1.3 Contrast. Detectable warning surfaces shall contrast visually with adjacent walking surfaces either light-on-dark, or dark-on-light.

705.2 Platform edges. Detectable warning surfaces at platform boarding edges shall be 24 inches wide and shall extend the full length of the areas of the platform.

SECTION 706 ASSISTIVE LISTENING SYSTEMS

706.1 General. Assistive listening systems required in assembly areas shall comply with this Section.

Advisory 706.1 General. Assistive listening systems are generally categorized by their mode of transmission. There are hard-wired systems and three types of wireless systems: induction loop, infrared, and FM radio transmission. Each has different advantages and disadvantages that can help determine which system is best for a given application. For example, an FM system may be better than an infrared system in some open-air assemblies since infrared signals are less effective in sunlight. On the other hand, an infrared system is typically a better choice than an FM system where confidential transmission is important because it will be contained within a given space.

The technical standards for assistive listening systems describe minimum performance levels for volume, interference, and distortion. Sound pressure levels (SPL), expressed in decibels, measure output sound volume. Signal-to-noise ratio (SNR or S/N), also expressed in decibels, represents the relationship between the loudness of a desired sound (the signal) and the background noise in a space or piece of equipment. The higher the SNR, the more intelligible the

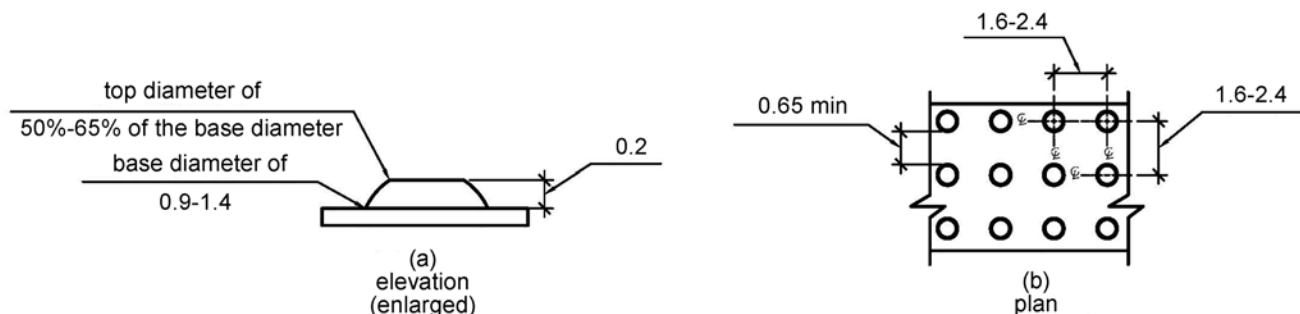


FIGURE 705.1
SIZE AND SPACING OF TRUNCATED DOMES

signal. The peak clipping level limits the distortion in signal output produced when high-volume sound waves are manipulated to serve assistive listening devices.

Selecting or specifying an effective assistive listening system for a large or complex venue requires assistance from a professional sound engineer. The Access Board has published technical assistance on assistive listening devices and systems.

706.2 Receiver jacks. Receivers required for use with an assistive listening system shall include a $\frac{1}{8}$ inch standard mono jack.

706.3 Receiver hearing-aid compatibility. Receivers required to be hearing-aid compatible shall interface with telecoils in hearing aids through the provision of neckloops.

Advisory 706.3 Receiver hearing-aid compatibility. Neckloops and headsets that can be worn as neckloops are compatible with hearing aids. Receivers that are not compatible include earbuds, which may require removal of hearing aids, earphones, and headsets that must be worn over the ear, which can create disruptive interference in the transmission and can be uncomfortable for people wearing hearing aids.

706.4 Sound pressure level. Assistive listening systems shall be capable of providing a sound pressure level of 110 dB minimum and 118 dB maximum with a dynamic range on the volume control of 50 dB.

706.5 Signal-to-noise ratio. The signal-to-noise ratio for internally generated noise in assistive listening systems shall be 18 dB minimum.

706.6 Peak clipping level. Peak clipping shall not exceed 18 dB of clipping relative to the peaks of speech.

SECTION 707 AUTOMATIC TELLER MACHINES AND FARE MACHINES

Advisory 707 Automatic teller machines and fare machines. Interactive transaction machines (ITMs), other than ATMs, are not covered by this Section. However, for entities covered by the ADA, the Department of Justice regulations that implement the ADA provide additional guidance regarding the relationship between these requirements and elements that are not directly addressed by these requirements. Federal procurement law requires that ITMs purchased by the Federal government comply with standards issued by the Access Board under Section 508 of the Rehabilitation Act of 1973, as amended. This law covers a variety of products, including computer hardware and software, web sites, phone systems, fax machines, copiers, and similar technologies. For more information on Section 508 consult the Access Board's web site at www.access-board.gov.

707.1 General. Automatic teller machines and fare machines shall comply with this Section.

Advisory 707.1 General. If farecards have one tactually distinctive corner they can be inserted with greater accuracy. Token collection devices that are designed to accommodate tokens which are perforated can allow a person to distinguish more readily between tokens and common coins. Place accessible gates and fare vending machines in close proximity to other accessible elements when feasible so the facility is easier to use.

707.2 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided.

Exception: Clear floor or ground space shall not be required at drive-up only automatic teller machines and fare machines.

707.3 Operable parts. Operable parts shall comply with Section 309. Unless a clear or correct key is provided, each operable part shall be able to be differentiated by sound or touch, without activation.

Exception: Drive-up only automatic teller machines and fare machines shall not be required to comply with Subsections 309.2 and 309.3.

707.4 Privacy. Automatic teller machines shall provide the opportunity for the same degree of privacy of input and output available to all individuals.

Advisory 707.4 Privacy. In addition to people who are blind or visually impaired, people with limited reach who use wheelchairs or have short stature, who cannot effectively block the ATM screen with their bodies, may prefer to use speech output. Speech output users can benefit from an option to render the visible screen blank, thereby affording them greater personal security and privacy.

707.5 Speech output. Machines shall be speech enabled. Operating instructions and orientation, visible transaction prompts, user input verification, error messages, and all displayed information for full use shall be accessible to and independently usable by individuals with vision impairments. Speech shall be delivered through a mechanism that is readily available to all users, including but not limited to, an industry standard connector or a telephone handset. Speech shall be recorded or digitized human, or synthesized.

Exceptions:

1. Audible tones shall be permitted instead of speech for visible output that is not displayed for security purposes, including but not limited to, asterisks representing personal identification numbers.
2. Advertisements and other similar information shall not be required to be audible unless they convey information that can be used in the transaction being conducted.
3. Where speech synthesis cannot be supported, dynamic alphabetic output shall not be required to be audible.

Advisory 707.5 Speech output. If an ATM provides additional functions such as dispensing coupons, selling theater tickets, or providing copies of monthly statements, all such functions must be available to customers using speech output. To avoid confusion at the ATM, the method of initiating the speech mode should be easily discoverable and should not require specialized training. For example, if a telephone handset is provided, lifting the handset can initiate the speech mode.

707.5.1 User control. Speech shall be capable of being repeated or interrupted. Volume control shall be provided for the speech function.

Exception: Speech output for any single function shall be permitted to be automatically interrupted when a transaction is selected.

707.5.2 Receipts. Where receipts are provided, speech output devices shall provide audible balance inquiry information, error messages, and all other information on the printed receipt necessary to complete or verify the transaction.

Exceptions:

1. Machine location, date and time of transaction, customer account number, and the machine identifier shall not be required to be audible.
2. Information on printed receipts that duplicates information available on-screen shall not be required to be presented in the form of an audible receipt.
3. Printed copies of bank statements and checks shall not be required to be audible.

707.6 Input. Input devices shall comply with this Subsection.

707.6.1 Input controls. At least one tactilely discernible input control shall be provided for each function. Where provided, key surfaces not on active areas of display screens, shall be raised above surrounding surfaces. Where membrane keys are the only method of input, each shall be tactilely discernible from surrounding surfaces and adjacent keys.

707.6.2 Numeric keys. Numeric keys shall be arranged in a 12-key ascending or descending telephone keypad layout. The number five key shall be tactilely distinct from the other keys.

Advisory 707.6.2 Numeric keys. Telephone keypads and computer keyboards differ in one significant feature, ascending versus descending numerical order. Both types of keypads are acceptable, provided the computer-style keypad is organized similarly to the number pad located at the right on most computer keyboards, and does not resemble the line of numbers located above the computer keys.

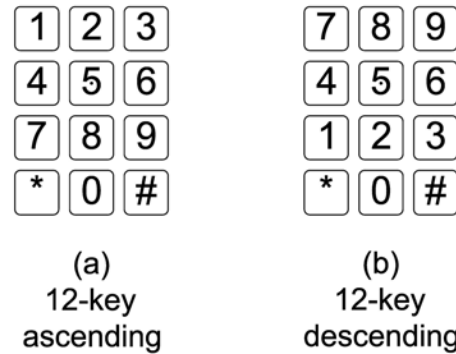


FIGURE 707.6.2
NUMERIC KEY LAYOUT

707.6.3 Function keys. Function keys shall comply with this Subsection.

707.6.3.1 Contrast. Function keys shall contrast visually from background surfaces. Characters and symbols on key surfaces shall contrast visually from key surfaces. Visual contrast shall be either light-on-dark or dark-on-light.

Exception: Tactile symbols required by Subsection 707.6.3.2 shall not be required to comply with this Subsection.

707.6.3.2 Tactile symbols. Function key surfaces shall have tactile symbols as follows: Enter or Proceed key: raised circle; Clear or Correct key: raised left arrow; Cancel key: raised letter ex; Add Value key: raised plus sign; Decrease Value key: raised minus sign.

707.7 Display screen. The display screen shall comply with this Subsection.

Exception: Drive-up only automatic teller machines and fare machines shall not be required to comply with Subsection 707.7.1.

707.7.1 Visibility. The display screen shall be visible from a point located 40 inches above the center of the clear floor space in front of the machine.

707.7.2 Characters. Characters displayed on the screen shall be in a sans serif font. Characters shall be $\frac{3}{16}$ inch high minimum based on the uppercase letter "I". Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background.

707.8 Braille instructions. Braille instructions for initiating the speech mode shall be provided. Braille shall comply with Subsection 703.3.

SECTION 708 TWO-WAY COMMUNICATION SYSTEMS

708.1 General. Two-way communication systems shall comply with this Section.

Advisory 708.1 General. Devices that do not require handsets are easier to use by people who have a limited reach.

708.2 Audible and visual indicators. The system shall provide both audible and visual signals.

Advisory 708.2 Audible and visual indicators. A light can be used to indicate visually that assistance is on the way. Signs indicating the meaning of visual signals should be provided.

708.3 Handsets. Handset cords, if provided, shall be 29 inches long minimum.

708.4 Residential dwelling unit communication systems. Communications systems between a residential dwelling unit and a site, building, or floor entrance shall comply with this Subsection.

708.4.1 Common use or public use system interface. The common use or public use system interface shall include the capability of supporting voice and TTY communication with the residential dwelling unit interface.

708.4.2 Residential dwelling unit interface. The residential dwelling unit system interface shall include a telephone jack capable of supporting voice and TTY communication with the common use or public use system interface.

CHAPTER 8

SPECIAL ROOMS, SPACES AND ELEMENTS

SECTION 801 GENERAL

801.1 Scope. The provisions of this Chapter shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

Advisory 801.1 Scope. Facilities covered by these requirements are also subject to the requirements of the other chapters. For example, Section 806 addresses guestrooms in transient lodging facilities while Section 902 contains the technical specifications for dining surfaces. If a transient lodging facility contains a restaurant, the restaurant must comply with requirements in other chapters such as those applicable to certain dining surfaces.

SECTION 802 WHEELCHAIR SPACES, COMPANION SEATS, AND DESIGNATED AISLE SEATS

802.1 Wheelchair Spaces. Wheelchair spaces shall comply with this Subsection.

802.1.1 Floor or ground surface. The floor or ground surface of wheelchair spaces shall comply with Section 302. Changes in level are not permitted.

Exception: Slopes not steeper than 1:48 shall be permitted.

802.1.2 Width. A single wheelchair space shall be 36 inches wide minimum. Where two adjacent wheelchair spaces are provided, each wheelchair space shall be 33 inches wide minimum.

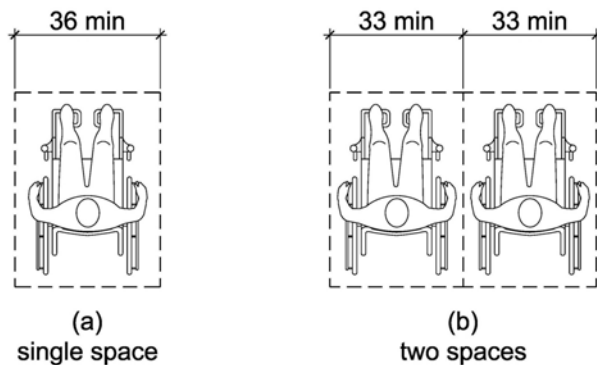


FIGURE 802.1.2
WIDTH OF WHEELCHAIR SPACES IN ASSEMBLY AREAS

802.1.3 Depth. Where a wheelchair space can be entered from the front or rear, the wheelchair space shall be 48 inches deep minimum. Where a wheelchair space can be entered only from the side, the wheelchair space shall be 60 inches deep minimum.

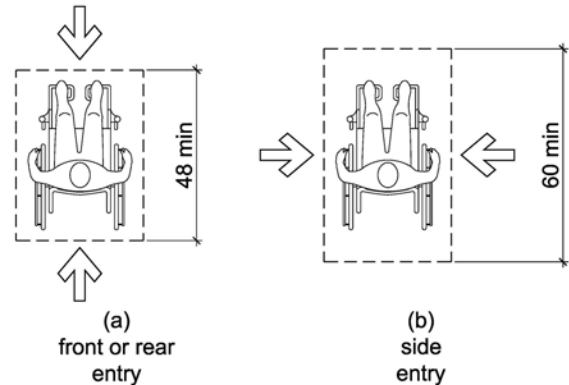


FIGURE 802.1.3
DEPTH OF WHEELCHAIR SPACES IN ASSEMBLY AREAS

802.1.4 Approach. Wheelchair spaces shall adjoin accessible routes. Accessible routes shall not overlap wheelchair spaces.

Advisory 802.1.4 Approach. Because accessible routes serving wheelchair spaces are not permitted to overlap the clear floor space at wheelchair spaces, access to any wheelchair space cannot be through another wheelchair space.

802.1.5 Overlap. Wheelchair spaces shall not overlap circulation paths.

Advisory 802.1.5 Overlap. The term “circulation paths” used in this Subsection means aisle width required by applicable building or life safety codes for the specific assembly occupancy. Where the circulation path provided is wider than the required aisle width, the wheelchair space may intrude into that portion of the circulation path that is provided in excess of the required aisle width.

802.2 Lines of sight. Lines of sight to the screen, performance area, or playing field for spectators in wheelchair spaces shall comply with this Subsection.

802.2.1 Lines of sight over seated spectators. Where spectators are expected to remain seated during events, spectators in wheelchair spaces shall be afforded lines of sight complying with this Subsection.

802.2.1.1 Lines of sight over heads. Where spectators are provided lines of sight over the heads of spectators seated in the first row in front of their seats, spectators seated in wheelchair spaces shall be afforded lines of sight over the heads of seated spectators in the first row in front of wheelchair spaces.

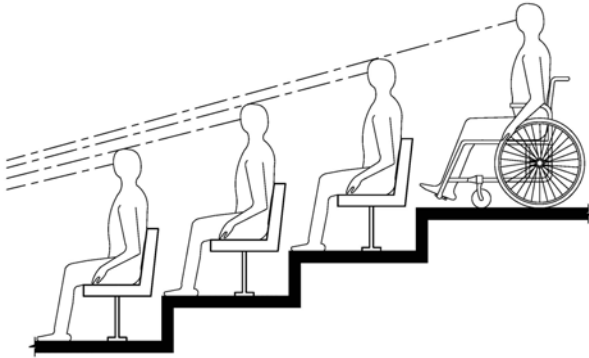


FIGURE 802.2.1.1
LINES OF SIGHT OVER THE HEADS OF SEATED SPECTATORS

802.2.1.2 Lines of sight between heads. Where spectators are provided lines of sight over the shoulders and between the heads of spectators seated in the first row in front of their seats, spectators seated in wheelchair spaces shall be afforded lines of sight over the shoulders and between the heads of seated spectators in the first row in front of wheelchair spaces.

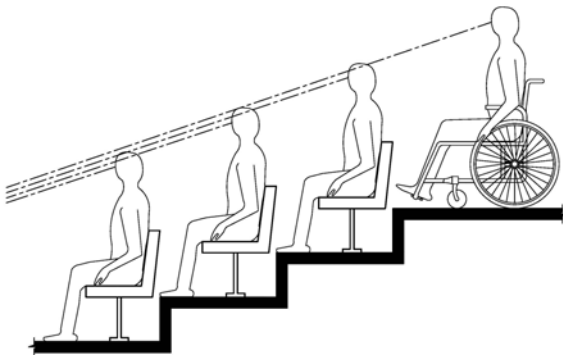


FIGURE 802.2.1.2
LINES OF SIGHT BETWEEN
THE HEADS OF SEATED SPECTATORS

802.2.2 Lines of sight over standing spectators. Where spectators are expected to stand during events, spectators in wheelchair spaces shall be afforded lines of sight complying with this Subsection.

802.2.2.1 Lines of sight over heads. Where standing spectators are provided lines of sight over the heads of spectators standing in the first row in front of their seats, spectators seated in wheelchair spaces shall be afforded lines of sight over the heads of standing spectators in the first row in front of wheelchair spaces.

802.2.2.2 Lines of sight between heads. Where standing spectators are provided lines of sight over the shoulders and between the heads of spectators standing in the first row in front of their seats, spectators seated in wheelchair spaces shall be afforded lines of sight over the shoulders and between the heads of standing spectators in the first row in front of wheelchair spaces.

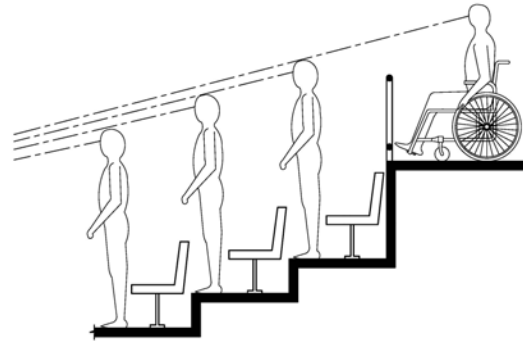


FIGURE 802.2.2.1
LINES OF SIGHT OVER THE HEADS
OF STANDING SPECTATORS

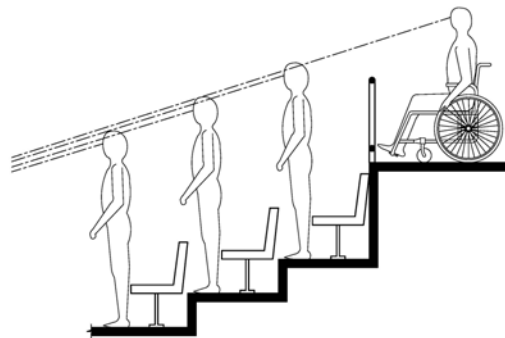


FIGURE 802.2.2.2
LINES OF SIGHT BETWEEN THE HEADS
OF STANDING SPECTATORS

802.3 Companion seats. Companion seats shall comply with this Subsection.

802.3.1 Alignment. In row seating, companion seats shall be located to provide shoulder alignment with adjacent wheelchair spaces. The shoulder alignment point of the wheelchair space shall be measured 36 inches from the front of the wheelchair space. The floor surface of the companion seat shall be at the same elevation as the floor surface of the wheelchair space.

802.3.2 Type. Companion seats shall be equivalent in size, quality, comfort, and amenities to the seating in the immediate area. Companion seats shall be permitted to be movable.

802.4 Designated aisle seats. Designated aisle seats shall comply with this Subsection.

802.4.1 Armrests. Where armrests are provided on the seating in the immediate area, folding or retractable armrests shall be provided on the aisle side of the seat.

802.4.2 Identification. Each designated aisle seat shall be identified by a sign or marker.

Advisory 802.4.2 Identification. Seats with folding or retractable armrests are intended for use by individuals who have difficulty walking. Consider identifying such seats with signs that contrast (light-on-dark or dark-on-light) and that are also photo luminescent.

SECTION 803 DRESSING, FITTING, AND LOCKER ROOMS

803.1 General. Dressing, fitting, and locker rooms shall comply with this Section.

Advisory 803.1 General. Partitions and doors should be designed to ensure people using accessible dressing and fitting rooms privacy equivalent to that afforded other users of the facility. Subsection 903.5 requires dressing room bench seats to be installed so that they are at the same height as a typical wheelchair seat, 17 inches to 19 inches. However, wheelchair seats can be lower than dressing room benches for people of short stature or children using wheelchairs.

803.2 Turning space. Turning space complying with Section 304 shall be provided within the room.

803.3 Door swing. Doors shall not swing into the room unless a clear floor or ground space complying with Subsection 305.3 is provided beyond the arc of the door swing.

803.4 Benches. A bench complying with Section 903 shall be provided within the room.

803.5 Coat hooks and shelves. Coat hooks provided within the room shall be located within one of the reach ranges specified in Section 308. Shelves shall be 40 inches minimum and 48 inches maximum above the finish floor or ground.

SECTION 804 KITCHENS AND KITCHENETTES

804.1 General. Kitchens and kitchenettes shall comply with this Section.

804.2 Clearance. Where a pass through kitchen is provided, clearances shall comply with Subsection 804.2.1. Where a U-shaped kitchen is provided, clearances shall comply with Subsection 804.2.2.

Exception: Spaces that do not provide a cooktop or conventional range shall not be required to comply with this Subsection.

Advisory 804.2 Clearance. Clearances are measured from the furthest projecting face of all opposing base cabinets, counter tops, appliances, or walls, excluding hardware.

804.2.1 Pass through kitchen. In pass through kitchens where counters, appliances or cabinets are on two opposing sides, or where counters, appliances or cabinets are opposite a parallel wall, clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 40 inches minimum. Pass through kitchens shall have two entries.

804.2.2 U-Shaped. In U-shaped kitchens enclosed on three contiguous sides, clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 60 inches minimum.

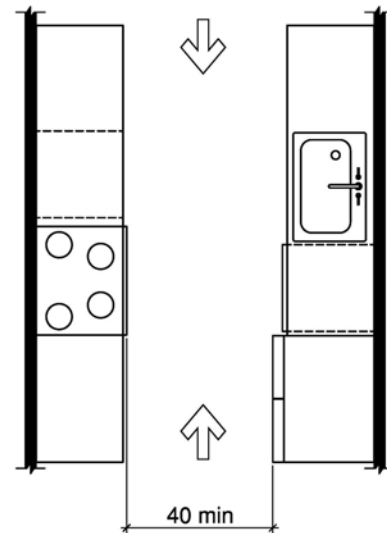


FIGURE 804.2.1
PASS THROUGH KITCHENS

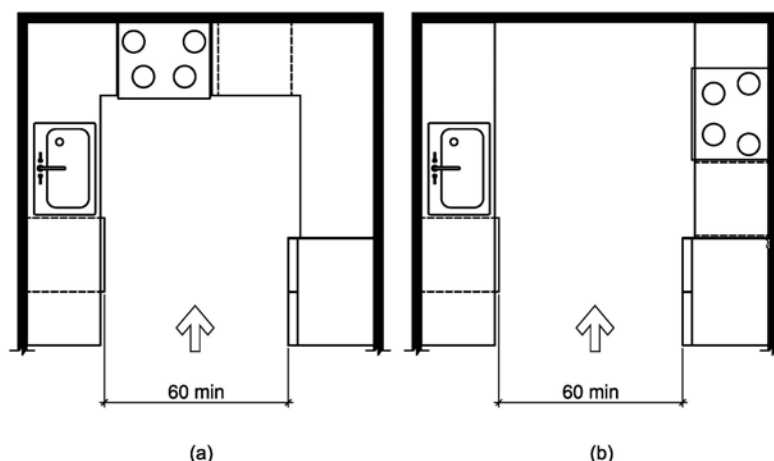


FIGURE 804.2.2
U-SHAPED KITCHENS

804.3 Kitchen work surface. In residential dwelling units required to comply with Section 809, at least one 30 inches wide minimum section of counter shall provide a kitchen work surface that complies with this Subsection.

804.3.1 Clear floor or ground space. A clear floor space complying with Section 305 positioned for a forward approach shall be provided. The clear floor or ground space shall be centered on the kitchen work surface and shall provide knee and toe clearance complying with Section 306.

Exception: Cabinetry shall be permitted under the kitchen work surface provided that all of the following conditions are met:

1. the cabinetry can be removed without removal or replacement of the kitchen work surface;
2. the finish floor extends under the cabinetry; and
3. the walls behind and surrounding the cabinetry are finished.

804.3.2 Height. The kitchen work surface shall be 34 inches maximum above the finish floor or ground.

Exception: A counter that is adjustable to provide a kitchen work surface at variable heights, 29 inches minimum and 36 inches maximum, shall be permitted.

804.3.3 Exposed surfaces. There shall be no sharp or abrasive surfaces under the work surface counters.

804.4 Sinks. Sinks shall comply with Section 606.

804.5 Storage. At least 50 percent of shelf space in storage facilities shall comply with Section 811.

804.6 Appliances. Where provided, kitchen appliances shall comply with this Subsection.

804.6.1 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided at each kitchen appliance. Clear floor or ground spaces shall be permitted to overlap.

804.6.2 Operable parts. All appliance controls shall comply with Section 309.

Exceptions:

1. Appliance doors and door latching devices shall not be required to comply with Subsection 309.4.
2. Bottom-hinged appliance doors, when in the open position, shall not be required to comply with Subsection 309.3.

804.6.3 Dishwasher. Clear floor or ground space shall be positioned adjacent to the dishwasher door. The dishwasher door, in the open position, shall not obstruct the clear floor or ground space for the dishwasher or the sink.

804.6.4 Range or cooktop. Where a forward approach is provided, the clear floor or ground space shall provide knee and toe clearance complying with Section 306. Where knee and toe space is provided, the underside of the range or cooktop shall be insulated or otherwise configured to prevent burns, abrasions, or electrical shock. The location of controls shall not require reaching across burners.

804.6.5 Oven. Ovens shall comply with this Subsection.

804.6.5.1 Side-hinged door ovens. Side-hinged door ovens shall have the work surface required by Subsection 804.3 positioned adjacent to the latch side of the oven door.

804.6.5.2 Bottom-hinged door ovens. Bottom-hinged door ovens shall have the work surface required by Subsection 804.3 positioned adjacent to one side of the door.

804.6.5.3 Controls. Ovens shall have controls on front panels.

804.6.6 Refrigerator/freezer. Combination refrigerators and freezers shall have at least 50 percent of the freezer space 54 inches maximum above the finish floor or ground. The clear floor or ground space shall be positioned for a parallel approach to the space dedicated to a refrigerator/freezer with the centerline of the clear floor or ground space offset 24 inches maximum from the centerline of the dedicated space.

SECTION 805 MEDICAL CARE AND LONG-TERM CARE FACILITIES

805.1 General. Medical care facility and long-term care facility patient or resident sleeping rooms required to provide mobility features shall comply with this Section.

805.2 Turning space. Turning space complying with Section 304 shall be provided within the room.

805.3 Clear floor or ground space. A clear floor space complying with Section 305 shall be provided on each side of the bed. The clear floor space shall be positioned for parallel approach to the side of the bed.

805.4 Toilet and bathing rooms. Toilet and bathing rooms that are provided as part of a patient or resident sleeping room shall comply with Section 603. Where provided, no fewer than one water closet, one lavatory, and one bathtub or shower shall comply with the applicable requirements of Sections 603 through 610.

SECTION 806 TRANSIENT LODGING GUESTROOMS

806.1 General. Transient lodging guestrooms shall comply with this Section. Guestrooms required to provide mobility features shall comply with Subsection 806.2. Guestrooms required to provide communication features shall comply with Subsection 806.3.

All buildings, structures, or facilities licensed as a hotel, motel or condominium pursuant to Chapter 509, F.S., shall comply with Subsection 806.4.

806.2 Guestrooms with mobility features. Guestrooms required to provide mobility features shall comply with this Subsection.

Advisory 806.2 Guestrooms. The requirements in this Subsection do not include requirements that are common to all accessible spaces. For example, closets in guestrooms must comply with the applicable provisions for storage specified in scoping.

806.2.1 Living and dining areas. Living and dining areas shall be accessible.

806.2.2 Exterior spaces. Exterior spaces, including patios, terraces and balconies, that serve the guestroom shall be accessible.

806.2.3 Sleeping areas. At least one sleeping area shall provide a clear floor space complying with Section 305 on both sides of a bed. The clear floor space shall be positioned for parallel approach to the side of the bed.

Exception: Where a single clear floor space complying with Section 305 positioned for parallel approach is provided between two beds, a clear floor or ground space shall not be required on both sides of a bed.

806.2.4 Toilet and bathing facilities. At least one bathroom that is provided as part of a guestroom shall comply with Section 603. No fewer than one water closet, one lavatory, and one bathtub or shower shall comply with applicable requirements of Sections 603 through 610. In addition, required roll-in shower compartments shall comply with Subsection 608.2.2 or 608.2.3. Toilet and bathing fixtures required to comply with Sections 603 through 610 shall be permitted to be located in more than one toilet or bathing area, provided that travel between fixtures does not require travel between other parts of the guestroom.

806.2.4.1 Vanity counter top space. If vanity counter top space is provided in nonaccessible guest toilet or bathing rooms, comparable vanity counter top space, in terms of size and proximity to the lavatory, shall also be provided in accessible guest toilet or bathing rooms.

Advisory 806.2.4.1 Vanity counter top space. This provision is intended to ensure that accessible guestrooms are provided with comparable vanity counter top space.

806.2.5 Kitchens and kitchenettes. Kitchens and kitchenettes shall comply with Section 804.

806.2.6 Turning space. Turning space complying with Section 304 shall be provided within the guestroom.

806.3 Guestrooms with communication features. Guestrooms required to provide communication features shall comply with this Subsection.

Advisory 806.3 Guestrooms with communication features. In guestrooms required to have accessible communication features, consider ensuring compatibility with adaptive equipment used by people with hearing impairments. To ensure communication within the facility, as well as on commercial lines, provide telephone interface jacks that are compatible with both digital and analog signal use. If an audio headphone jack is provided on a speaker phone, a cutoff switch can be included in the jack so that insertion of the jack cuts off the speaker. If a telephone-like handset is

used, the external speakers can be turned off when the handset is removed from the cradle. For headset or external amplification system compatibility, a standard subminiature jack installed in the telephone will provide the most flexibility.

806.3.1 Alarms. Where emergency warning systems are provided, alarms complying with Section 702 shall be provided.

806.3.2 Notification devices. Visible notification devices shall be provided to alert room occupants of incoming telephone calls and a door knock or bell. Notification devices shall not be connected to visible alarm signal appliances. Telephones shall have volume controls compatible with the telephone system and shall comply with Subsection 704.3. Telephones shall be served by an electrical outlet complying with Section 309 located within 48 inches of the telephone to facilitate the use of a TTY.

806.4 Hotel, motel and condominium special accessibility features. This Section does not relieve the owner of the responsibility of providing accessible rooms in conformance with Sections 224 and 806 of this Code. In all buildings, structures and facilities licensed as a hotel, motel or resort condominium pursuant to Chapter 509, F.S., a number of rooms equaling at least 5 percent of the guestrooms minus the Total Number of Required (accessible) Rooms required by Table 224.2 shall provide the following additional special accessibility features:

- (i) Grab rails in bathrooms and toilet rooms which comply with Subsection 604.5.
- (ii) All beds in designed accessible guestrooms shall be open-frame type that allows the passage of lift devices.
- (iii) Water closets that comply with Subsection 604.4.

SECTION 807 HOLDING CELLS AND HOUSING CELLS

807.1 General. Holding cells and housing cells shall comply with this Section.

807.2 Cells with mobility features. Cells required to provide mobility features shall comply with this Subsection.

807.2.1 Turning space. Turning space complying with Section 304 shall be provided within the cell.

807.2.2 Benches. Where benches are provided, at least one bench shall comply with Section 903.

807.2.3 Beds. Where beds are provided, clear floor space complying with Section 305 shall be provided on at least one side of the bed. The clear floor space shall be positioned for parallel approach to the side of the bed.

807.2.4 Toilet and bathing facilities. Toilet facilities or bathing facilities that are provided as part of a cell shall comply with Section 603. Where provided, no fewer than one water closet, one lavatory, and one bathtub or shower shall comply with the applicable requirements of Sections 603 through 610.

Advisory 807.2.4 Toilet and bathing facilities. In holding cells, housing cells, or rooms required to be accessible, these requirements do not require a separate toilet room.

807.3 Cells with communication features. Cells required to provide communication features shall comply with this Subsection.

807.3.1 Alarms. Where audible emergency alarm systems are provided to serve the occupants of cells, visible alarms complying with Section 702 shall be provided.

Exception: Visible alarms shall not be required where inmates or detainees are not allowed independent means of egress.

807.3.2 Telephones. Telephones, where provided within cells, shall have volume controls complying with Subsection 704.3.

SECTION 808 COURTROOMS

808.1 General. Courtrooms shall comply with this Section.

808.2 Turning space. Where provided, areas that are raised or depressed and accessed by ramps or platform lifts with entry ramps shall provide unobstructed turning space complying with Section 304.

808.3 Clear floor space. Each jury box and witness stand shall have, within its defined area, clear floor space complying with Section 305.

Exception: In alterations, wheelchair spaces are not required to be located within the defined area of raised jury boxes or witness stands and shall be permitted to be located outside these spaces where ramp or platform lift access poses a hazard by restricting or projecting into a means of egress required by the appropriate administrative authority.

808.4 Judges' benches and courtroom stations. Judges' benches, clerks' stations, bailiffs' stations, deputy clerks' stations, court reporters' stations and litigants' and counsel stations shall comply with Section 902.

SECTION 809 RESIDENTIAL DWELLING UNITS

809.1 General. Residential dwelling units shall comply with this Section. Residential dwelling units required to provide mobility features shall comply with Subsections 809.2 through 809.4. Residential dwelling units required to provide communication features shall comply with Subsection 809.5.

809.2 Accessible routes. Accessible routes complying with Chapter 4 shall be provided within residential dwelling units in accordance with this Subsection.

Exception: Accessible routes shall not be required to or within unfinished attics or unfinished basements.

809.2.1 Location. At least one accessible route shall connect all spaces and elements which are a part of the residential dwelling unit. Where only one accessible route is provided, it shall not pass through bathrooms, closets, or similar spaces.

809.2.2 Turning space. All rooms served by an accessible route shall provide a turning space complying with Section 304.

Exception: Turning space shall not be required in exterior spaces 30 inches maximum in depth or width.

Advisory 809.2.2 Turning space. It is generally acceptable to use required clearances to provide wheelchair turning space. For example, in kitchens, Subsection 804.3.1 requires at least one work surface with clear floor space complying with Section 306 to be centered beneath. If designers elect to provide clear floor space that is at least 36 inches wide, as opposed to the required 30 inches wide, that clearance can be part of a T-turn, thereby maximizing efficient use of the kitchen area. However, the overlap of turning space must be limited to one segment of the T-turn so that back-up maneuvering is not restricted. It would, therefore, be unacceptable to use both the clearances under the work surface and the sink as part of a T-turn. See Subsection 304.3.2 regarding T-turns.

809.3 Kitchen. Where a kitchen is provided, it shall comply with Section 804.

809.4 Toilet facilities and bathing facilities. At least one bathroom shall comply with Section 603. No fewer than one of each type of fixture provided shall comply with applicable requirements of Sections 603 through 610. Toilet and bathing fixtures required to comply with Sections 603 through 610 shall be located in the same toilet and bathing area, such that travel between fixtures does not require travel between other parts of the residential dwelling unit.

Advisory 809.4 Toilet facilities and bathing facilities. In an effort to promote space efficiency, vanity counter top space in accessible residential dwelling units is often omitted. This omission does not promote equal access or equal enjoyment of the unit. Where comparable units have vanity counter tops, accessible units should also have vanity counter tops located as close as possible to the lavatory for convenient access to toiletries.

809.5 Residential dwelling units with communication features. Residential dwelling units required to provide communication features shall comply with this Subsection.

809.5.1 Building fire alarm system. Where a building fire alarm system is provided, the system wiring shall be extended to a point within the residential dwelling unit in the vicinity of the residential dwelling unit smoke detection system.

809.5.1.1 Alarm appliances. Where alarm appliances are provided within a residential dwelling unit as part of the building fire alarm system, they shall comply with Section 702.

809.5.1.2 Activation. All visible alarm appliances provided within the residential dwelling unit for building fire alarm notification shall be activated upon activation of the building fire alarm in the portion of the building containing the residential dwelling unit.

809.5.2 Residential dwelling unit smoke detection system. Residential dwelling unit smoke detection systems shall comply with NFPA 72 (1999 or 2002 edition) (incor-

porated by reference, see “Referenced Standards” in Chapter 1).

809.5.2.1 Activation. All visible alarm appliances provided within the residential dwelling unit for smoke detection notification shall be activated upon smoke detection.

809.5.3 Interconnection. The same visible alarm appliances shall be permitted to provide notification of residential dwelling unit smoke detection and building fire alarm activation.

809.5.4 Prohibited use. Visible alarm appliances used to indicate residential dwelling unit smoke detection or building fire alarm activation shall not be used for any other purpose within the residential dwelling unit.

809.5.5 Residential dwelling unit primary entrance. Communication features shall be provided at the residential dwelling unit primary entrance complying with this Subsection.

809.5.5.1 Notification. A hard-wired electric doorbell shall be provided. A button or switch shall be provided outside the residential dwelling unit primary entrance. Activation of the button or switch shall initiate an audible tone and visible signal within the residential dwelling unit. Where visible doorbell signals are located in sleeping areas, they shall have controls to deactivate the signal.

809.5.5.2 Identification. A means for visually identifying a visitor without opening the residential dwelling unit entry door shall be provided and shall allow for a minimum 180 degree range of view.

Advisory 809.5.5.2 Identification. In doors, peepholes that include prisms clarify the image and should offer a wide-angle view of the hallway or exterior for both standing persons and wheelchair users. Such peepholes can be placed at a standard height and permit a view from several feet from the door.

809.5.6 Site, building, or floor entrance. Where a system, including a closed-circuit system, permitting voice communication between a visitor and the occupant of the residential dwelling unit is provided, the system shall comply with Subsection 708.4.

SECTION 810 TRANSPORTATION FACILITIES

810.1 General. Transportation facilities shall comply with this Section.

810.2 Bus boarding and alighting areas. Bus boarding and alighting areas shall comply with this Subsection.

Advisory 810.2 Bus boarding and alighting areas. At bus stops where a shelter is provided, the bus stop pad can be located either within or outside of the shelter.

810.2.1 Surface. Bus stop boarding and alighting areas shall have a firm, stable surface.

810.2.2 Dimensions. Bus stop boarding and alighting areas shall provide a clear length of 96 inches minimum, measured perpendicular to the curb or vehicle roadway edge, and a clear width of 60 inches minimum, measured parallel to the vehicle roadway.

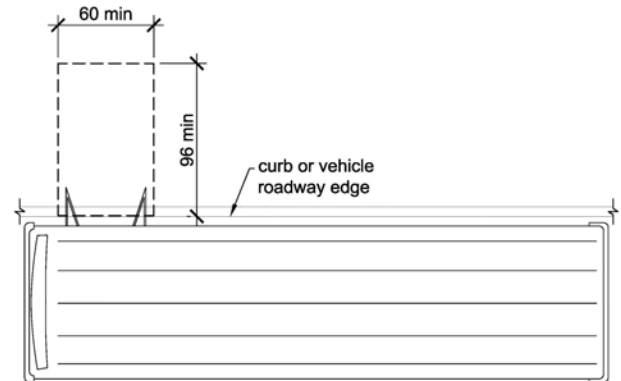


FIGURE 810.2.2
DIMENSIONS OF BUS BOARDING AND ALIGHTING AREAS

810.2.3 Connection. Bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route complying with Section 402.

810.2.4 Slope. Parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than 1:48.

810.3 Bus shelters. Bus shelters shall provide a minimum clear floor or ground space complying with Section 305 entirely within the shelter. Bus shelters shall be connected by an accessible route complying with Section 402 to a boarding and alighting area complying with Subsection 810.2.

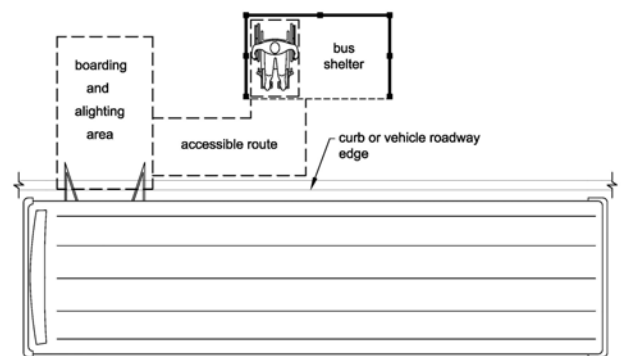


FIGURE 810.3
BUS SHELTERS

810.4 Bus signs. Bus route identification signs shall comply with Subsections 703.5.1 through 703.5.4, and 703.5.7 and 703.5.8. In addition, to the maximum extent practicable, bus route identification signs shall comply with Subsection 703.5.5.

Exception: Bus schedules, timetables and maps that are posted at the bus stop or bus bay shall not be required to comply.

810.5 Rail platforms. Rail platforms shall comply with this Subsection.

810.5.1 Slope. Rail platforms shall not exceed a slope of 1:48 in all directions.

Exception: Where platforms serve vehicles operating on existing track or track laid in existing roadway, the slope of the platform parallel to the track shall be permitted to be equal to the slope (grade) of the roadway or existing track.

810.5.2 Detectable warnings. Platform boarding edges not protected by platform screens or guards shall have detectable warnings complying with Section 705 along the full length of the public use area of the platform.

810.5.3 Platform and vehicle floor coordination. Station platforms shall be positioned to coordinate with vehicles in accordance with the applicable requirements of 36 CFR Part 1192. Low-level platforms shall be 8 inches minimum above top of rail. In light rail, commuter rail, and intercity rail systems subject to Department of Transportation regulation 49 CFR 37.21 where it is not operationally or structurally feasible to meet the horizontal gap or vertical difference requirements of part 1192 or 49 CFR part 38, mini-high platforms, car-borne or platform-mounted lifts, ramps or bridge plates or similarly manually deployed devices, meeting the requirements of 49 CFR part 38, shall suffice.

Exception: Where vehicles are boarded from sidewalks or street-level, low-level platforms shall be permitted to be less than 8 inches.

Advisory 810.5.3 Platform and vehicle floor coordination. The height and position of a platform must be coordinated with the floor of the vehicles it serves to minimize the vertical and horizontal gaps, in accordance with the ADA Accessibility Guidelines for Transportation Vehicles (36 CFR Part 1192). The vehicle guidelines, divided by bus, van, light rail, rapid rail, commuter rail, intercity rail, are available at www.access-board.gov. The preferred alignment is a high platform, level with the vehicle floor. In some cases, the vehicle guidelines permit use of a low platform in conjunction with a lift or ramp. Most such low platforms must have a minimum height of eight inches above the top of the rail. Some vehicles are designed to be boarded from a street or the sidewalk along the street and the exception permits such boarding areas to be less than 8 inches high.

810.6 Rail station signs. Rail station signs shall comply with this Subsection.

Exception: Signs shall not be required to comply with Subsections 810.6.1 and 810.6.2 where audible signs are remotely transmitted to hand-held receivers, or are user- or proximity-actuated.

Advisory 810.6 Rail station signs exception. Emerging technologies such as an audible sign system using infrared transmitters and receivers may provide greater accessibility in the transit environment than traditional Braille and raised

letter signs. The transmitters are placed on or next to print signs and transmit their information to an infrared receiver that is held by a person. By scanning an area, the person will hear the sign. This means that signs can be placed well out of reach of Braille readers, even on parapet walls and on walls beyond barriers. Additionally, such signs can be used to provide way-finding information that cannot be efficiently conveyed on Braille signs.

810.6.1 Entrances. Where signs identify a station or its entrance, at least one sign at each entrance shall comply with Subsection 703.2 and shall be placed in uniform locations to the maximum extent practicable. Where signs identify a station that has no defined entrance, at least one sign shall comply with Subsection 703.2 and shall be placed in a central location.

810.6.2 Routes and destinations. Lists of stations, routes and destinations served by the station which are located on boarding areas, platforms, or mezzanines shall comply with Subsection 703.5. At least one tactile sign identifying the specific station and complying with Subsection 703.2 shall be provided on each platform or boarding area. Signs covered by this requirement shall, to the maximum extent practicable, be placed in uniform locations within the system.

Exception: Where sign space is limited, characters shall not be required to exceed 3 inches.

Advisory 810.6.2 Routes and destinations. Route maps are not required to comply with the informational sign requirements in this Code.

810.6.3 Station names. Stations covered by this Section shall have identification signs complying with Subsection 703.5. Signs shall be clearly visible and within the sight lines of standing and sitting passengers from within the vehicle on both sides when not obstructed by another vehicle.

Advisory 810.6.3 Station names. It is also important to place signs at intervals in the station where passengers in the vehicle will be able to see a sign when the vehicle is either stopped at the station or about to come to a stop in the station. The number of signs necessary may be directly related to the size of the lettering displayed on the sign.

810.7 Public address systems. Where public address systems convey audible information to the public, the same or equivalent information shall be provided in a visual format.

810.8 Clocks. Where clocks are provided for use by the public, the clock face shall be uncluttered so that its elements are clearly visible. Hands, numerals and digits shall contrast with the background either light-on-dark or dark-on-light. Where clocks are installed overhead, numerals and digits shall comply with Subsection 703.5.

810.9 Escalators. Where provided, escalators shall comply with the Sections 6.1.3.5.6 and 6.1.3.6.5 of ASME A17.1 (incorporated by reference, see "Referenced Standards" in Chapter 1) and shall have a clear width of 32 inches minimum.

Exception: Existing escalators in key stations shall not be required to comply with this Subsection.

810.10 Track Crossings. Where a circulation path serving boarding platforms crosses tracks, it shall comply with Section 402.

Exception: Openings for wheel flanges shall be permitted to be $2\frac{1}{2}$ inches maximum.



**FIGURE 810.10 (EXCEPTION)
TRACK CROSSINGS**

SECTION 811 STORAGE

811.1 General. Storage shall comply with this Section.

811.2 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided.

811.3 Height. Storage elements shall comply with at least one of the reach ranges specified in Section 308.

811.4 Operable parts. Operable parts shall comply with Section 309.

CHAPTER 9

BUILT-IN ELEMENTS

SECTION 901 GENERAL

901.1 Scope. The provisions of this Chapter shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

SECTION 902 DINING SURFACES AND WORK SURFACES

902.1 General. Dining surfaces and work surfaces shall comply with Subsections 902.2 and 902.3.

Exception: Dining surfaces and work surfaces for children's use shall be permitted to comply with Subsection 902.4.

Advisory 902.1 General. Dining surfaces include, but are not limited to, bars, tables, lunch counters, and booths. Examples of work surfaces include writing surfaces, study carrels, student laboratory stations, baby changing and other tables or fixtures for personal grooming, coupon counters, and where covered by the ABA scoping provisions, employee work stations.

902.2 Clear floor or ground space. A clear floor space complying with Section 305 positioned for a forward approach shall be provided. Knee and toe clearance complying with Section 306 shall be provided.

902.3 Height. The tops of dining surfaces and work surfaces shall be 28 inches minimum and 34 inches maximum above the finish floor or ground.

902.4 Dining surfaces and work surfaces for children's use. Accessible dining surfaces and work surfaces for children's use shall comply with this Subsection.

Exception: Dining surfaces and work surfaces that are used primarily by children five years and younger shall not be required to comply with this Subsection where a clear floor or ground space complying with Subsection 305 positioned for a parallel approach is provided.

902.4.1 Clear floor or ground space. A clear floor space complying with Section 305 positioned for forward approach shall be provided. Knee and toe clearance complying with Section 306 shall be provided, except that knee clearance 24 inches minimum above the finish floor or ground shall be permitted.

902.4.2 Height. The tops of tables and counters shall be 26 inches minimum and 30 inches maximum above the finish floor or ground.

SECTION 903 BENCHES

903.1 General. Benches shall comply with this Section.

903.2 Clear floor or ground space. Clear floor or ground space complying with Section 305 shall be provided and shall be positioned at the end of the bench seat and parallel to the short axis of the bench.

903.3 Size. Benches shall have seats that are 42 inches long minimum and 20 inches deep minimum and 24 inches deep maximum.

903.4 Back support. The bench shall provide for back support or shall be affixed to a wall. Back support shall be 42 inches long minimum and shall extend from a point 2 inches maximum above the seat surface to a point 18 inches minimum above the seat surface. Back support shall be 2½ inches maximum from the rear edge of the seat measured horizontally.

Advisory 903.4 Back support. To assist in transferring to the bench, consider providing grab bars on a wall adjacent to the bench, but not on the seat back. If provided, grab bars cannot obstruct transfer to the bench.

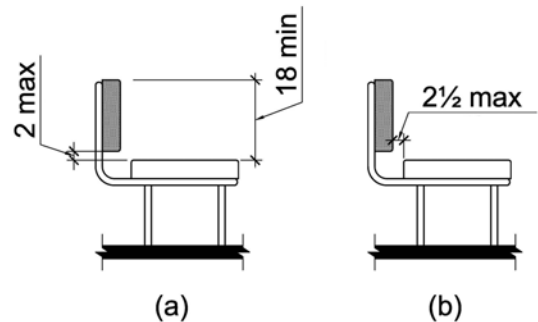


FIGURE 903.4
BENCH BACK SUPPORT

903.5 Height. The top of the bench seat surface shall be 17 inches minimum and 19 inches maximum above the finish floor or ground.

903.6 Structural strength. Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds is applied at any point on the seat, fastener, mounting device, or supporting structure.

903.7 Wet locations. Where installed in wet locations, the surface of the seat shall be slip resistant and shall not accumulate water.

SECTION 904 CHECK-OUT AISLES AND SALES AND SERVICE COUNTERS

904.1 General. Check-out aisles and sales and service counters shall comply with the applicable requirements of this Section.

904.2 Approach. All portions of counters required to comply with Section 904 shall be located adjacent to a walking surface complying with Section 403.

Advisory 904.2 Approach. If a cash register is provided at the sales or service counter, locate the accessible counter close to the cash register so that a person using a wheelchair is visible to sales or service personnel and to minimize the reach for a person with a disability.

904.3 Check-out aisles. Check-out aisles shall comply with this Subsection.

904.3.1 Aisle. Aisles shall comply with Section 403.

904.3.2 Counter. The counter surface height shall be 38 inches maximum above the finish floor or ground. The top of the counter edge protection shall be 2 inches maximum above the top of the counter surface on the aisle side of the check-out counter.

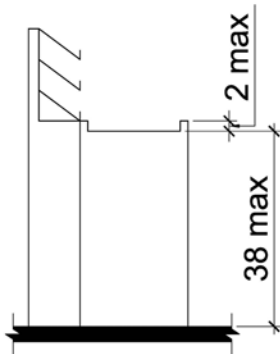


FIGURE 904.3.2
CHECK-OUT AISLE COUNTERS

904.3.3 Check writing surfaces. Where provided, check writing surfaces shall comply with Subsection 902.3.

904.4 Sales and service counters. Sales counters and service counters shall comply with Subsection 904.4.1 or 904.4.2. The accessible portion of the counter top shall extend the same depth as the sales or service counter top.

Exception: In alterations, when the provision of a counter complying with this Subsection would result in a reduction of the number of existing counters at work stations or a reduction of the number of existing mail boxes, the counter shall be permitted to have a portion which is 24 inches long minimum complying with Subsection 904.4.1 provided that the required clear floor or ground space is centered on the accessible length of the counter.

904.4.1 Parallel approach. A portion of the counter surface that is 36 inches long minimum and 36 inches high maximum above the finish floor shall be provided. A clear floor or ground space complying with Section 305 shall be positioned for a parallel approach adjacent to the 36 inch minimum length of counter.

Exception: Where the provided counter surface is less than 36 inches long, the entire counter surface shall be 36 inches high maximum above the finish floor.

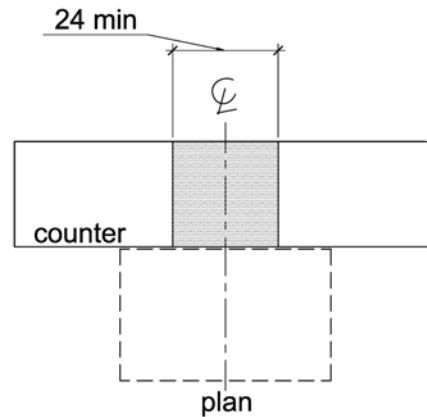


FIGURE 904.4 (EXCEPTION)
ALTERATION OF SALES AND SERVICE COUNTERS

904.4.2 Forward approach. A portion of the counter surface that is 30 inches long minimum and 36 inches high maximum shall be provided. Knee and toe space complying with Section 306 shall be provided under the counter. A clear floor or ground space complying with Section 305 shall be positioned for a forward approach to the counter.

904.5 Food service lines. Counters in food service lines shall comply with this Subsection.

904.5.1 Self-service shelves and dispensing devices. Self-service shelves and dispensing devices for tableware, dishware, condiments, food and beverages shall comply with Section 308.

904.5.2 Tray slides. The tops of tray slides shall be 28 inches minimum and 34 inches maximum above the finish floor or ground.

904.6 Security glazing. Where counters or teller windows have security glazing to separate personnel from the public, a method to facilitate voice communication shall be provided. Telephone handset devices, if provided, shall comply with Subsection 704.3.

Advisory 904.6 Security glazing. Assistive listening devices complying with Section 706 can facilitate voice communication at counters or teller windows where there is security glazing which promotes distortion in audible information. Where assistive listening devices are installed, place signs complying with Subsection 703.7.2.4 to identify those facilities which are so equipped. Other voice communication methods include, but are not limited to, grilles, slats, talk-through baffles, intercoms, or telephone handset devices.

CHAPTER 10

RECREATION FACILITIES

SECTION 1001 GENERAL

1001.1 Scope. The provisions of this Chapter shall apply where required by Chapter 2 or where referenced by a requirement in this Code.

Advisory 1001.1 Scope. Unless otherwise modified or specifically addressed in this Chapter, all other ADAAG provisions apply to the design and construction of recreation facilities and elements. The provisions in this Subsection apply wherever these elements are provided. For example, office buildings may contain a room with exercise equipment to which these sections would apply.

SECTION 1002 AMUSEMENT RIDES

1002.1 General. Amusement rides shall comply with this Section.

1002.2 Accessible routes. Accessible routes serving amusement rides shall comply with Chapter 4.

Exceptions:

1. In load or unload areas and on amusement rides, where compliance with Subsection 405.2 is not structurally or operationally feasible, ramp slope shall be permitted to be 1:8 maximum.
2. In load or unload areas and on amusement rides, handrails provided along walking surfaces complying with Section 403 and required on ramps complying with Section 405 shall not be required to comply with Section 505 where compliance is not structurally or operationally feasible.

Advisory 1002.2 Accessible routes Exception 1. Steeper slopes are permitted on accessible routes connecting the amusement ride in the load and unload position where it is "structurally or operationally infeasible." In most cases, this will be limited to areas where the accessible route leads directly to the amusement ride and where there are space limitations on the ride, not the queue line. Where possible, the least possible slope should be used on the accessible route that serves the amusement ride.

1002.3 Load and unload areas. A turning space complying with Subsections 304.2 and 304.3 shall be provided in load and unload areas.

1002.4 Wheelchair spaces in amusement rides. Wheelchair spaces in amusement rides shall comply with this Subsection.

1002.4.1 Floor or ground surface. The floor or ground surface of wheelchair spaces shall be stable and firm.

1002.4.2 Slope. The floor or ground surface of wheelchair spaces shall have a slope not steeper than 1:48 when in the load and unload position.

1002.4.3 Gaps. Floors of amusement rides with wheelchair spaces and floors of load and unload areas shall be coordinated so that, when amusement rides are at rest in the load and unload position, the vertical difference between the floors shall be within plus or minus $\frac{5}{8}$ inches and the horizontal gap shall be 3 inches maximum under normal passenger load conditions.

Exception: Where compliance is not operationally or structurally feasible, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) shall be provided.

Advisory 1002.4.3 Gaps Exception. 36 CFR 1192.83(c) *ADA Accessibility Guidelines for Transportation Vehicles – Light Rail Vehicles and Systems – Mobility Aid Accessibility* is available at www.access-board.gov. It includes provisions for bridge plates and ramps that can be used at gaps between wheelchair spaces and floors of load and unload areas.

1002.4.4 Clearances. Clearances for wheelchair spaces shall comply with this Subsection.

Exceptions:

1. Where provided, securement devices shall be permitted to overlap required clearances.
2. Wheelchair spaces shall be permitted to be mechanically or manually repositioned.
3. Wheelchair spaces shall not be required to comply with Subsection 307.4.

Advisory 1002.4.4 Clearances Exception 3. This exception for protruding objects applies to the ride devices, not to circulation areas or accessible routes in the queue lines or the load and unload areas.

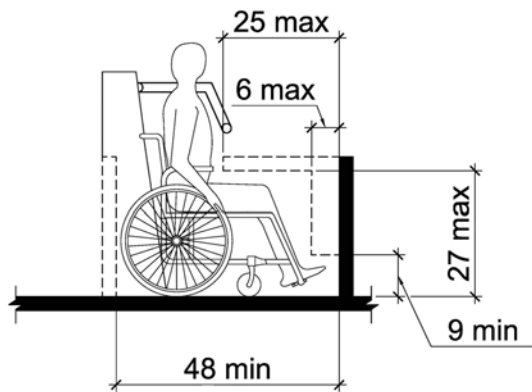
1002.4.4.1 Width and length. Wheelchair spaces shall provide a clear width of 30 inches minimum and a clear length of 48 inches minimum measured to 9 inches minimum above the floor surface.

1002.4.4.2 Side entry. Where wheelchair spaces are entered only from the side, amusement rides shall be designed to permit sufficient maneuvering clearance for individuals using a wheelchair or mobility aid to enter and exit the ride.

Advisory 1002.4.4.2 Side entry. The amount of clear space needed within the ride, and the size and position of the opening are interrelated. A 32 inch clear opening will not pro-

vide sufficient width when entered through a turn into an amusement ride. Additional space for maneuvering and a wider door will be needed where a side opening is centered on the ride. For example, where a 42 inch opening is provided, a minimum clear space of 60 inches in length and 36 inches in depth is needed to ensure adequate space for maneuvering.

1002.4.4.3 Permitted protrusions in wheelchair spaces. Objects are permitted to protrude a distance of 6 inches maximum along the front of the wheelchair space, where located 9 inches minimum and 27 inches maximum above the floor or ground surface of the wheelchair space. Objects are permitted to protrude a distance of 25 inches maximum along the front of the wheelchair space, where located more than 27 inches above the floor or ground surface of the wheelchair space.



**FIGURE 1002.4.4.3
PROTRUSIONS IN WHEELCHAIR SPACES
IN AMUSEMENT RIDES**

1002.4.5 Ride entry. Openings providing entry to wheelchair spaces on amusement rides shall be 32 inches minimum clear.

1002.4.6 Approach. One side of the wheelchair space shall adjoin an accessible route when in the load and unload position.

1002.4.7 Companion seats. Where the interior width of the amusement ride is greater than 53 inches, seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat shall be provided for each wheelchair space.

1002.4.7.1 Shoulder-to-shoulder seating. Where an amusement ride provides shoulder-to-shoulder seating, companion seats shall be shoulder-to-shoulder with the adjacent wheelchair space.

Exception: Where shoulder-to-shoulder companion seating is not operationally or structurally feasible, compliance with this requirement shall be required to the maximum extent practicable.

1002.5 Amusement ride seats designed for transfer.

Amusement ride seats designed for transfer shall comply with this Subsection when positioned for loading and unloading.

Advisory 1002.5 Amusement ride seats designed for transfer. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonal to the element will provide flexibility and will increase usability for a more diverse population of individuals with disabilities. Ride seats designed for transfer should involve only one transfer. Where possible, designers are encouraged to locate the ride seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, providing gripping surfaces, seat padding, and avoiding sharp objects in the path of transfer will facilitate the transfer.

1002.5.1 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided in the load and unload area adjacent to the amusement ride seats designed for transfer.

1002.5.2 Transfer height. The height of amusement ride seats designed for transfer shall be 14 inches minimum and 24 inches maximum measured from the surface of the load and unload area.

1002.5.3 Transfer entry. Where openings are provided for transfer to amusement ride seats, the openings shall provide clearance for transfer from a wheelchair or mobility aid to the amusement ride seat.

1002.5.4 Wheelchair storage space. Wheelchair storage spaces complying with Section 305 shall be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer and shall not overlap any required means of egress or accessible route.

1002.6 Transfer devices for use with amusement rides. Transfer devices for use with amusement rides shall comply with this Subsection when positioned for loading and unloading.

Advisory 1002.6 Transfer devices for use with amusement rides. Transfer devices for use with amusement rides should permit individuals to make independent transfers to and from their wheelchairs or mobility devices. There are a variety of transfer devices available that could be adapted to provide access onto an amusement ride. Examples of devices that may provide for transfers include, but are not limited to, transfer systems, lifts, mechanized seats, and custom designed systems. Operators and designers have flexibility in developing designs that will facilitate individuals to transfer onto amusement rides. These systems or devices should be designed to be reliable and sturdy.

Designs that limit the number of transfers required from a wheelchair or mobility device to the ride seat are encouraged. When using a transfer device to access an amusement

ride, the least number of transfers and the shortest distance is most usable. Where possible, designers are encouraged to locate the transfer device seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, providing gripping surfaces, seat padding, and avoiding sharp objects in the path of transfer will facilitate the transfer. Where a series of transfers are required to reach the amusement ride seat, each vertical transfer should not exceed 8 inches.

1002.6.1 Clear floor or ground space. A clear floor or ground space complying with Section 305 shall be provided in the load and unload area adjacent to the transfer device.

1002.6.2 Transfer height. The height of transfer device seats shall be 14 inches minimum and 24 inches maximum measured from the load and unload surface.

1002.6.3 Wheelchair storage space. Wheelchair storage spaces complying with Section 305 shall be provided in or adjacent to unload areas for each required transfer device and shall not overlap any required means of egress or accessible route.

SECTION 1003 RECREATIONAL BOATING FACILITIES

1003.1 General. Recreational boating facilities shall comply with this Section.

1003.2 Accessible routes. Accessible routes serving recreational boating facilities, including gangways and floating piers, shall comply with Chapter 4 except as modified by the exceptions in this Subsection.

1003.2.1 Boat slips. Accessible routes serving boat slips shall be permitted to use the exceptions in this Subsection.

Exceptions:

1. Where an existing gangway or series of gangways is replaced or altered, an increase in the length of the gangway shall not be required to comply with Subsection 1003.2 unless required by Subsection 202.4.
2. Gangways shall not be required to comply with the maximum rise specified in Subsection 405.6.
3. Where the total length of a gangway or series of gangways serving as part of a required accessible route is 80 feet minimum, gangways shall not be required to comply with Subsection 405.2.
4. Where facilities contain fewer than 25 boat slips and the total length of the gangway or series of gangways serving as part of a required accessible route is 30 feet minimum, gangways shall not be required to comply with Subsection 405.2.
5. Where gangways connect to transition plates, landings specified by Subsection 405.7 shall not be required.

6. Where gangways and transition plates connect and are required to have handrails, handrail extensions shall not be required. Where handrail extensions are provided on gangways or transition plates, the handrail extensions shall not be required to be parallel with the ground or floor surface.
7. The cross slope specified in Subsections 403.3 and 405.3 for gangways, transition plates, and floating piers that are part of accessible routes shall be measured in the static position.
8. Changes in level complying with Subsections 303.3 and 303.4 shall be permitted on the surfaces of gangways and boat launch ramps.

Advisory 1003.2.1 Boat slips Exception 3. The following example shows how Exception 3 would be applied: A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 3 permits the gangway to be 80 feet long. Another design solution would be to have two 40 foot plus continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

1003.2.2 Boarding piers at boat launch ramps. Accessible routes serving boarding piers at boat launch ramps shall be permitted to use the exceptions in this Subsection.

Exceptions:

1. Accessible routes serving floating boarding piers shall be permitted to use Exceptions 1, 2, 5, 6, 7 and 8 in Subsection 1003.2.1.
2. Where the total length of the gangway or series of gangways serving as part of a required accessible route is 30 feet minimum, gangways shall not be required to comply with Subsection 405.2.
3. Where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, the portion of the accessible route located within the boat launch ramp shall not be required to comply with Section 405.

1003.3 Clearances. Clearances at boat slips and on boarding piers at boat launch ramps shall comply with this Subsection.

Advisory 1003.3 Clearances. Although the minimum width of the clear pier space is 60 inches, it is recommended that piers be wider than 60 inches to improve the safety for persons with disabilities, particularly on floating piers.

1003.3.1 Boat slip clearance. Boat slips shall provide clear pier space 60 inches wide minimum and at least as long as the boat slips. Each 10 feet maximum of linear pier edge serving boat slips shall contain at least one continuous clear opening 60 inches wide minimum.

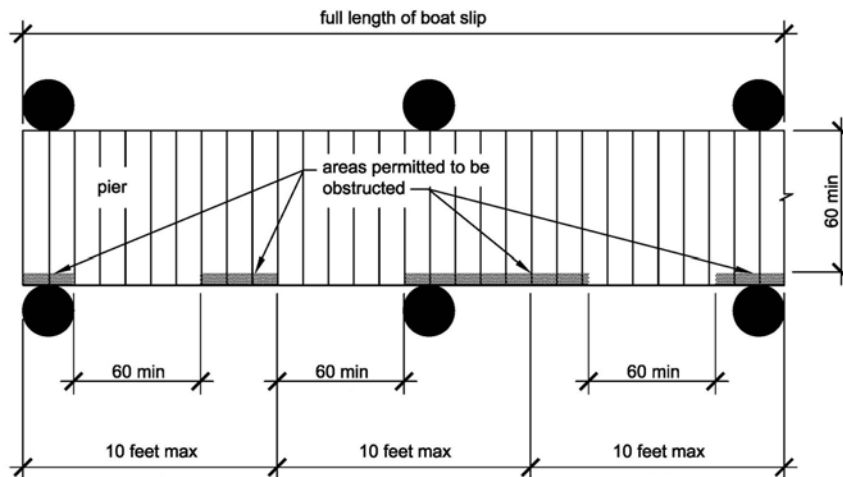
Exceptions:

1. Clear pier space shall be permitted to be 36 inches wide minimum for a length of 24 inches maximum, provided that multiple 36 inch wide segments are separated by segments that are 60 inches wide minimum and 60 inches long minimum.
2. Edge protection shall be permitted at the continuous clear openings, provided that it is 4 inches high maximum and 2 inches wide maximum.
3. In existing piers, clear pier space shall be permitted to be located perpendicular to the boat slip and shall extend the width of the boat slip, where

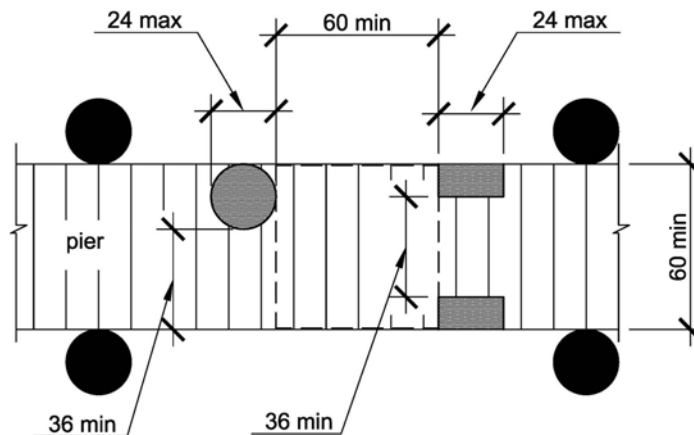
the facility has at least one boat slip complying with Subsection 1003.3, and further compliance with Subsection 1003.3 would result in a reduction in the number of boat slips available or result in a reduction of the widths of existing slips.

Advisory 1003.3.1 Boat slip clearance Exception 3.

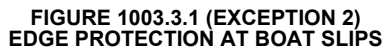
Where the conditions in Exception 3 are satisfied, existing facilities are only required to have one accessible boat slip with a pier clearance which runs the length of the slip. All other accessible slips are allowed to have the required pier clearance at the head of the slip. Under this exception, at piers with perpendicular boat slips, the width of most “finger piers” will remain unchanged. However, where mooring systems for floating piers are replaced as part of pier alteration projects, an opportunity may exist for increasing accessibility. Piers may be reconfigured to allow an increase in the number of wider finger piers, and serve as accessible boat slips.



**FIGURE 1003.3.1
BOAT SLIP CLEARANCE**



**FIGURE 1003.3.1 (EXCEPTION 1)
CLEAR PIER SPACE REDUCTION AT BOAT SLIPS**



Exceptions:

1. The clear pier space shall be permitted to be 36 inches wide minimum for a length of 24 inches maximum provided that multiple 36 inch wide segments are separated by segments that are 60 inches wide minimum and 60 inches long minimum.
2. Edge protection shall be permitted at the continuous clear openings provided that it is 4 inches high maximum and 2 inches wide maximum.

applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20 foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in Subsection 1003.3. Likewise, if a 60 foot long accessible boarding pier is provided, the pier clearance requirements in Subsection 1003.3 would apply to the entire 60 feet.

The following example applies to a boat launch ramp boarding pier: A chain of floats is provided on a launch ramp to be used as a boarding pier which is required to be accessible by this Subsection. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp.

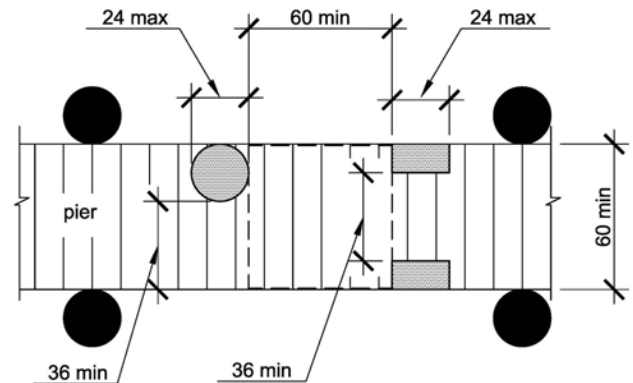


FIGURE 1003.3.2 (EXCEPTION 1)
CLEAR PIER SPACE REDUCTION AT BOARDING PIERS

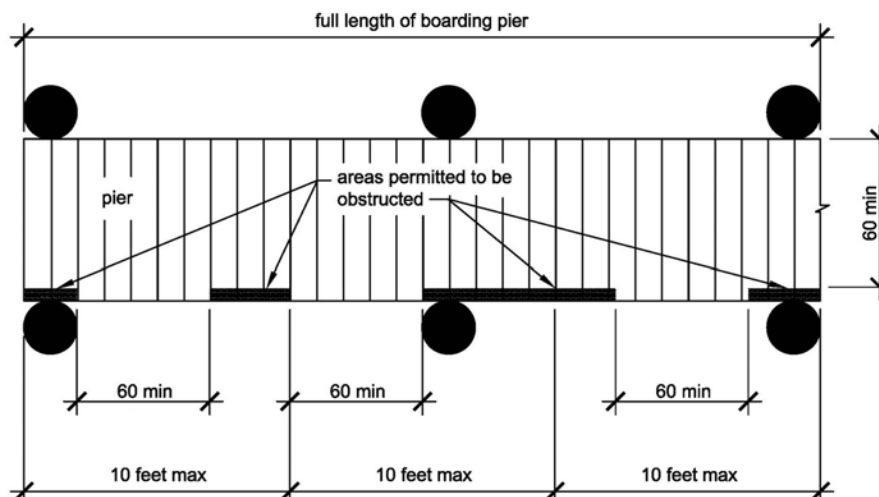


FIGURE 1003.3.2
BOARDING PIER CLEARANCE

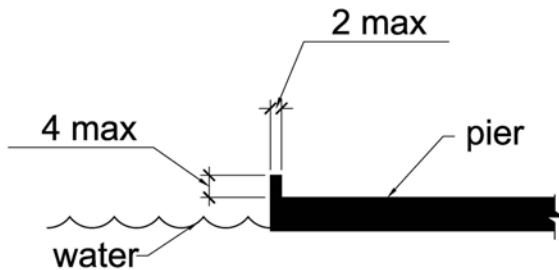


FIGURE 1003.3.2 (EXCEPTION 2)
EDGE PROTECTION AT BOARDING PIERS

SECTION 1004 EXERCISE MACHINES AND EQUIPMENT

1004.1 Clear floor space. Exercise machines and equipment shall have a clear floor space complying with Section 305 positioned for transfer or for use by an individual seated in a wheelchair. Clear floor or ground spaces required at exercise machines and equipment shall be permitted to overlap.

Advisory 1004.1 Clear floor space. One clear floor or ground space is permitted to be shared between two pieces of exercise equipment. To optimize space use, designers should carefully consider layout options such as connecting ends of the row and center aisle spaces. The position of the clear floor space may vary greatly depending on the use of the equipment or machine. For example, to provide access to a shoulder press machine, clear floor space next to the seat would be appropriate to allow for transfer. Clear floor space for a bench press machine designed for use by an individual seated in a wheelchair, however, will most likely be centered on the operating mechanisms.

SECTION 1005 FISHING PIERS AND PLATFORMS

1005.1 Accessible routes. Accessible routes serving fishing piers and platforms, including gangways and floating piers, shall comply with Chapter 4.

Exceptions:

1. Accessible routes serving floating fishing piers and platforms shall be permitted to use Exceptions 1, 2, 5, 6, 7 and 8 in Subsection 1003.2.1.
2. Where the total length of the gangway or series of gangways serving as part of a required accessible route is 30 feet minimum, gangways shall not be required to comply with Subsection 405.2.

1005.2 Railings. Where provided, railings, guards, or handrails shall comply with this Subsection.

1005.2.1 Height. At least 25 percent of the railings, guards, or handrails shall be 34 inches maximum above the ground or deck surface.

Exception: Where a guard complies with Subsection 503.11 of the *EPCOT Building Code*, the guard shall not be required to comply with this Subsection.

1005.2.1.1 Dispersion. Railings, guards, or handrails required to comply with Subsection 1005.2.1 shall be dispersed throughout the fishing pier or platform.

Advisory 1005.2.1.1 Dispersion. Portions of the railings that are lowered to provide fishing opportunities for persons with disabilities must be located in a variety of locations on the fishing pier or platform to give people a variety of locations to fish. Different fishing locations may provide varying water depths, shade (at certain times of the day), vegetation, and proximity to the shoreline or bank.

1005.3 Edge protection. Where railings, guards, or handrails complying with Subsection 1005.2 are provided, edge protection complying with Subsection 1005.3.1 or 1005.3.2 shall be provided.

Advisory 1005.3 Edge protection. Edge protection is required only where railings, guards, or handrails are provided on a fishing pier or platform. Edge protection will prevent wheelchairs or other mobility devices from slipping off the fishing pier or platform. Extending the deck of the fishing pier or platform 12 inches where the 34 inch high railing is provided is an alternative design, permitting individuals using wheelchairs or other mobility devices to pull into a clear space and move beyond the face of the railing. In such a design, curbs or barriers are not required.

1005.3.1 Curb or barrier. Curbs or barriers shall extend 2 inches minimum above the surface of the fishing pier or platform.

1005.3.2 Extended ground or deck surface. The ground or deck surface shall extend 12 inches minimum beyond the inside face of the railing. Toe clearance shall be provided and shall be 30 inches wide minimum and 9 inches minimum above the ground or deck surface beyond the railing.

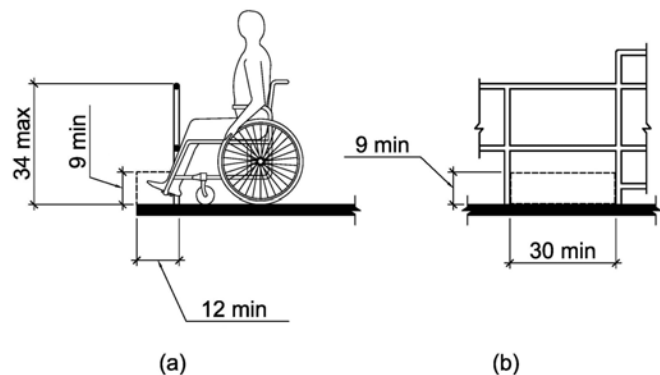


FIGURE 1005.3.2
EXTENDED GROUND OR DECK SURFACE
AT FISHING PIERS AND PLATFORMS

1005.4 Clear floor or ground space. At each location where there are railings, guards, or handrails complying with Subsection 1005.2.1, a clear floor or ground space complying with Section 305 shall be provided. Where there are no railings, guards, or handrails, at least one clear floor or ground space complying with Section 305 shall be provided on the fishing pier or platform.

1005.5 Turning space. At least one turning space complying with Subsection 304.3 shall be provided on fishing piers and platforms.

SECTION 1006 GOLF FACILITIES

1006.1 General. Golf facilities shall comply with this Section.

1006.2 Accessible routes. Accessible routes serving teeing grounds, practice teeing grounds, putting greens, practice putting greens, teeing stations at driving ranges, course weather shelters, golf car rental areas, bag drop areas, and course toilet rooms shall comply with Chapter 4 and shall be 48 inches wide minimum. Where handrails are provided, accessible routes shall be 60 inches wide minimum.

Exception: Handrails shall not be required on golf courses. Where handrails are provided on golf courses, the handrails shall not be required to comply with Section 505.

Advisory 1006.2 Accessible routes. The 48 inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes to be located outside the boundary of the course. For example, an accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision.

Providing a golf car passage will permit a person that uses a golf car to practice driving a golf ball from the same position and stance used when playing the game. Additionally, the space required for a person using a golf car to enter and maneuver within the teeing stations required to be accessible should be considered.

1006.3 Golf car passages. Golf car passages shall comply with this Subsection.

1006.3.1 Clear width. The clear width of golf car passages shall be 48 inches minimum.

1006.3.2 Barriers. Where curbs or other constructed barriers prevent golf cars from entering a fairway, openings

60 inches wide minimum shall be provided at intervals not to exceed 75 yards.

1006.4 Weather shelters. A clear floor or ground space 60 inches minimum by 96 inches minimum shall be provided within weather shelters.

SECTION 1007 MINIATURE GOLF FACILITIES

1007.1 General. Miniature golf facilities shall comply with this Section.

1007.2 Accessible routes. Accessible routes serving holes on miniature golf courses shall comply with Chapter 4. Accessible routes located on playing surfaces of miniature golf holes shall be permitted to use the exceptions in this Subsection.

Exceptions:

1. Playing surfaces shall not be required to comply with Subsection 302.2.
2. Where accessible routes intersect playing surfaces of holes, a 1 inch maximum curb shall be permitted for a width of 32 inches minimum.
3. A slope not steeper than 1:4 for a 4 inch maximum rise shall be permitted.
4. Ramp landing slopes specified by Subsection 405.7.1 shall be permitted to be 1:20 maximum.
5. Ramp landing length specified by Subsection 405.7.3 shall be permitted to be 48 inches long minimum.
6. Ramp landing size specified by Subsection 405.7.4 shall be permitted to be 48 inches minimum by 60 inches minimum.
7. Handrails shall not be required on holes. Where handrails are provided on holes, the handrails shall not be required to comply with Section 505.

1007.3 Miniature golf holes. Miniature golf holes shall comply with this Subsection.

1007.3.1 Start of play. A clear floor or ground space 48 inches minimum by 60 inches minimum with slopes not steeper than 1:48 shall be provided at the start of play.

1007.3.2 Golf club reach range area. All areas within holes where golf balls rest shall be within 36 inches maximum of a clear floor or ground space 36 inches wide minimum and 48 inches long minimum having a running slope not steeper than 1:20. The clear floor or ground space shall be served by an accessible route.

Advisory 1007.3.2 Golf club reach range area. The golf club reach range applies to all holes required to be accessible. This includes accessible routes provided adjacent to or, where provided, on the playing surface of the hole.

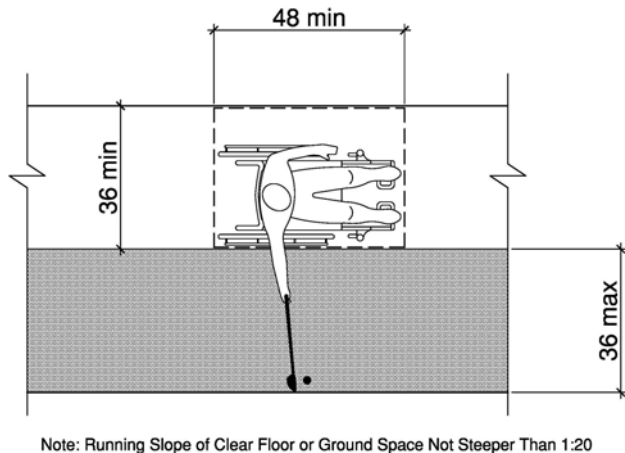


FIGURE 1007.3.2
GOLF CLUB REACH RANGE AREA

SECTION 1008 PLAY AREAS

1008.1 General. Play areas shall comply with this Section.

1008.2 Accessible routes. Accessible routes serving play areas shall comply with Chapter 4 and this Subsection and shall be permitted to use the exceptions in Subsections 1008.2.1 through 1008.2.3. Where accessible routes serve ground level play components, the vertical clearance shall be 80 inches high minimum.

1008.2.1 Ground level and elevated play components. Accessible routes serving ground level play components and elevated play components shall be permitted to use the exceptions in this Subsection.

Exceptions:

1. Transfer systems complying with Subsection 1008.3 shall be permitted to connect elevated play components except where 20 or more elevated play components are provided no more than 25 percent of the elevated play components shall be permitted to be connected by transfer systems.
2. Where transfer systems are provided, an elevated play component shall be permitted to connect to another elevated play component as part of an accessible route.

1008.2.2 Soft contained play structures. Accessible routes serving soft contained play structures shall be permitted to use the exception in this Subsection.

Exception: Transfer systems complying with Subsection 1008.3 shall be permitted to be used as part of an accessible route.

1008.2.3 Water play components. Accessible routes serving water play components shall be permitted to use the exceptions in this Subsection.

Exceptions:

1. Where the surface of the accessible route, clear floor or ground spaces, or turning spaces serving

water play components is submerged, compliance with Section 302, Subsections 403.3, 405.2, 405.3, and 1008.2.6 shall not be required.

2. Transfer systems complying with Subsection 1008.3 shall be permitted to connect elevated play components in water.

Advisory 1008.2.3 Water play components. Personal wheelchairs and mobility devices may not be appropriate for submerging in water when using play components in water. Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the water. Providing an aquatic wheelchair made of noncorrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs.

1008.2.4 Clear width. Accessible routes connecting play components shall provide a clear width complying with this Subsection.

1008.2.4.1 Ground level. At ground level, the clear width of accessible routes shall be 60 inches minimum.

Exceptions:

1. In play areas less than 1,000 square feet, the clear width of accessible routes shall be permitted to be 44 inches minimum, if at least one turning space complying with Subsection 304.3 is provided where the restricted accessible route exceeds 30 feet in length.
2. The clear width of accessible routes shall be permitted to be 36 inches minimum for a distance of 60 inches maximum provided that multiple reduced width segments are separated by segments that are 60 inches wide minimum and 60 inches long minimum.

1008.2.4.2 Elevated. The clear width of accessible routes connecting elevated play components shall be 36 inches minimum.

Exceptions:

1. The clear width of accessible routes connecting elevated play components shall be permitted to be reduced to 32 inches minimum for a distance of 24 inches maximum provided that reduced width segments are separated by segments that are 48 inches long minimum and 36 inches wide minimum.
2. The clear width of transfer systems connecting elevated play components shall be permitted to be 24 inches minimum.

1008.2.5 Ramps. Within play areas, ramps connecting ground level play components and ramps connecting elevated play components shall comply with this Subsection.

1008.2.5.1 Ground level. Ramp runs connecting ground level play components shall have a running slope not steeper than 1:16.

1008.2.5.2 Elevated. The rise for any ramp run connecting elevated play components shall be 12 inches maximum.

1008.2.5.3 Handrails. Where required on ramps serving play components, the handrails shall comply with Section 505 except as modified by this Subsection.

Exceptions:

1. Handrails shall not be required on ramps located within ground level use zones.
2. Handrail extensions shall not be required.

1008.2.5.3.1 Handrail gripping surfaces. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 0.95 inch minimum and 1.55 inches maximum. Where the shape of the gripping surface is noncircular, the handrail shall provide an equivalent gripping surface.

1008.2.5.3.2 Handrail height. The top of handrail gripping surfaces shall be 20 inches minimum and 28 inches maximum above the ramp surface.

1008.2.6 Ground surfaces. Ground surfaces on accessible routes, clear floor or ground spaces, and turning spaces shall comply with this Subsection.

Advisory 1008.2.6 Ground surfaces. Ground surfaces must be inspected and maintained regularly to ensure continued compliance with the ASTM F1951 standard. The type of surface material selected and play area use levels will determine the frequency of inspection and maintenance activities.

1008.2.6.1 Accessibility. Ground surfaces shall comply with ASTM F1951 (incorporated by reference, see “Referenced Standards” in Chapter 1). Ground surfaces shall be inspected and maintained regularly and frequently to ensure continued compliance with ASTM F1951.

1008.2.6.2 Use zones. Ground surfaces located within use zones shall comply with ASTM F1292 (1999 edi-

tion or 2004 edition) (incorporated by reference, see “Referenced Standards” in Chapter 1).

1008.3 Transfer systems. Where transfer systems are provided to connect to elevated play components, transfer systems shall comply with this Subsection.

Advisory 1008.3 Transfer systems. Where transfer systems are provided, consideration should be given to the distance between the transfer system and the elevated play components. Moving between a transfer platform and a series of transfer steps requires extensive exertion for some children. Designers should minimize the distance between the points where a child transfers from a wheelchair or mobility device and where the elevated play components are located. Where elevated play components are used to connect to another elevated play component instead of an accessible route, careful consideration should be used in the selection of the play components used for this purpose.

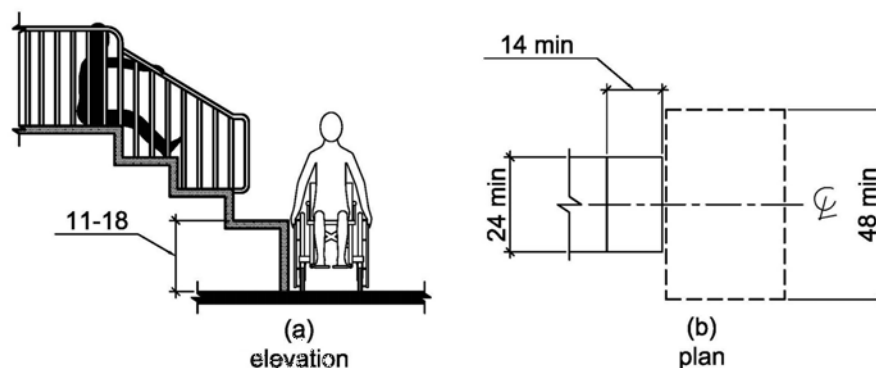
1008.3.1 Transfer platforms. Transfer platforms shall be provided where transfer is intended from wheelchairs or other mobility aids. Transfer platforms shall comply with this Subsection.

1008.3.1.1 Size. Transfer platforms shall have level surfaces 14 inches deep minimum and 24 inches wide minimum.

1008.3.1.2 Height. The height of transfer platforms shall be 11 inches minimum and 18 inches maximum measured to the top of the surface from the ground or floor surface.

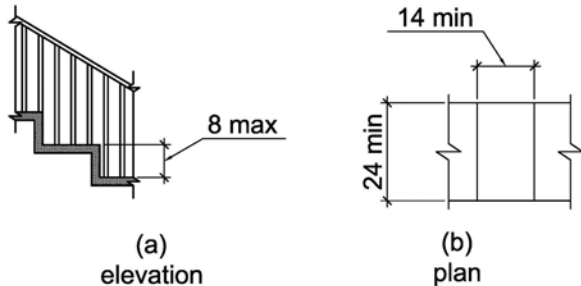
1008.3.1.3 Transfer Space. A transfer space complying with Subsections 305.2 and 305.3 shall be provided adjacent to the transfer platform. The 48 inch long minimum dimension of the transfer space shall be centered on and parallel to the 24 inch long minimum side of the transfer platform. The side of the transfer platform serving the transfer space shall be unobstructed.

1008.3.1.4 Transfer supports. At least one means of support for transferring shall be provided.



**FIGURE 1008.3.1
TRANSFER PLATFORMS**

1008.3.2 Transfer steps. Transfer steps shall be provided where movement is intended from transfer platforms to levels with elevated play components required to be on accessible routes. Transfer steps shall comply with this Subsection.



**FIGURE 1008.3.2
TRANSFER STEPS**

1008.3.2.1 Size. Transfer steps shall have level surfaces 14 inches deep minimum and 24 inches wide minimum.

1008.3.2.2 Height. Each transfer step shall be 8 inches high maximum.

1008.3.2.3 Transfer supports. At least one means of support for transferring shall be provided.

Advisory 1008.3.2.3 Transfer supports. Transfer supports are required on transfer platforms and transfer steps to assist children when transferring. Some examples of supports include a rope loop, a loop type handle, a slot in the edge of a flat horizontal or vertical member, poles or bars, or D rings on the corner posts.

1008.4 Play components. Ground level play components on accessible routes and elevated play components connected by ramps shall comply with this Subsection.

1008.4.1 Turning space. At least one turning space complying with Section 304 shall be provided on the same level as play components. Where swings are provided, the turning space shall be located immediately adjacent to the swing.

1008.4.2 Clear floor or ground space. Clear floor or ground complying with Subsections 305.2 and 305.3 shall be provided at play components.

Advisory 1008.4.2 Clear floor or ground space. Clear floor or ground spaces, turning spaces, and accessible routes are permitted to overlap within play areas. A specific location has not been designated for the clear floor or ground spaces or turning spaces, except swings, because each play component may require that the spaces be placed in a unique location. Where play components include a seat or entry point, designs that provide for an unobstructed transfer from a wheelchair or other mobility device are recommended. This will enhance the ability of children with disabilities to independently use the play component.

When designing play components with manipulative or interactive features, consider appropriate reach ranges for children seated in wheelchairs. The following table provides guidance on reach ranges for children seated in wheelchairs. These dimensions apply to either forward or side reaches. The reach ranges are appropriate for use with those play components that children seated in wheelchairs may access and reach. Where transfer systems provide access to elevated play components, the reach ranges are not appropriate.

**TABLE 1008.4.2
CHILDREN'S REACH RANGES**

FORWARD OR SIDE REACH	AGES 3 AND 4	AGES 5 THROUGH 8	AGES 9 THROUGH 12
High (maximum)	36 in	40 in	44 in
Low (minimum)	20 in	18 in	16 in

1008.4.3 Play tables. Where play tables are provided, knee clearance 24 inches high minimum, 17 inches deep minimum, and 30 inches wide minimum shall be provided. The tops of rims, curbs, or other obstructions shall be 31 inches high maximum.

Exception: Play tables designed and constructed primarily for children five years and younger shall not be required to provide knee clearance where the clear floor or ground space required by Subsection 1008.4.2 is arranged for a parallel approach.

1008.4.4 Entry points and seats. Where play components require transfer to entry points or seats, the entry points or seats shall be 11 inches minimum and 24 inches maximum from the clear floor or ground space.

Exception: Entry points of slides shall not be required to comply with this Subsection.

1008.4.5 Transfer supports. Where play components require transfer to entry points or seats, at least one means of support for transferring shall be provided.

SECTION 1009 SWIMMING POOLS, WADING POOLS, AND SPAS

1009.1 General. Where provided, pool lifts, sloped entries, transfer walls, transfer systems, and pool stairs shall comply with this Section.

1009.2 Pool lifts. Pool lifts shall comply with this Subsection.

Advisory 1009.2 Pool Lifts. There are a variety of seats available on pool lifts ranging from sling seats to those that are preformed or molded. Pool lift seats with backs will enable a larger population of persons with disabilities to use the lift. Pool lift seats that consist of materials that resist corrosion and provide a firm base to transfer will be usable by a wider range of people with disabilities. Additional options such as armrests, head rests, seat belts, and leg sup-

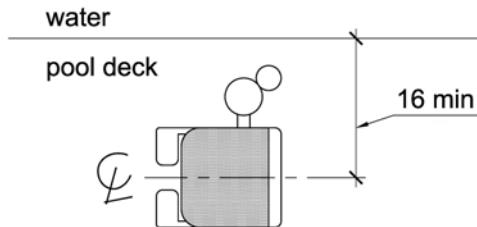
port will enhance accessibility and better accommodate people with a wide range of disabilities.

1009.2.1 Pool lift location. Pool lifts shall be located where the water level does not exceed 48 inches.

Exceptions:

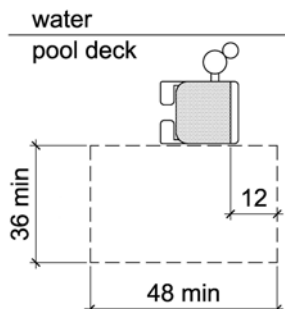
1. Where the entire pool depth is greater than 48 inches, compliance with this Subsection shall not be required.
2. Where multiple pool lift locations are provided, no more than one pool lift shall be required to be located in an area where the water level is 48 inches maximum.

1009.2.2 Seat location. In the raised position, the centerline of the seat shall be located over the deck and 16 inches minimum from the edge of the pool. The deck surface between the centerline of the seat and the pool edge shall have a slope not steeper than 1:48.



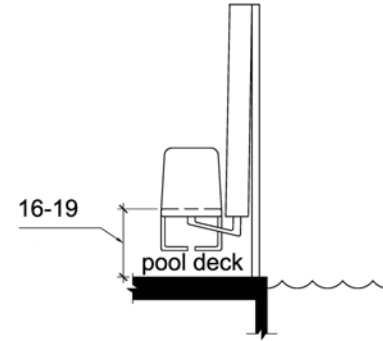
**FIGURE 1009.2.2
POOL LIFT SEAT LOCATION**

1009.2.3 Clear deck space. On the side of the seat opposite the water, a clear deck space shall be provided parallel with the seat. The space shall be 36 inches wide minimum and shall extend forward 48 inches minimum from a line located 12 inches behind the rear edge of the seat. The clear deck space shall have a slope not steeper than 1:48.



**FIGURE 1009.2.3
CLEAR DECK SPACE AT POOL LIFTS**

1009.2.4 Seat height. The height of the lift seat shall be designed to allow a stop at 16 inches minimum to 19 inches maximum measured from the deck to the top of the seat surface when in the raised (load) position.



**FIGURE 1009.2.4
POOL LIFT SEAT HEIGHT**

1009.2.5 Seat width. The seat shall be 16 inches wide minimum.

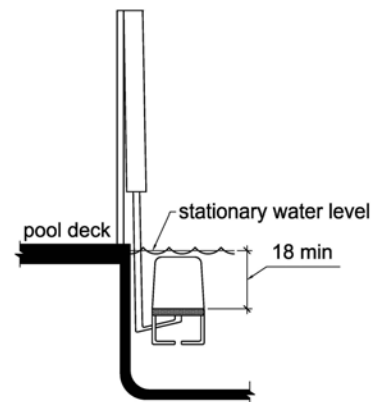
1009.2.6 Footrests and armrests. Footrests shall be provided and shall move with the seat. If provided, the armrest positioned opposite the water shall be removable or shall fold clear of the seat when the seat is in the raised (load) position.

Exception: Footrests shall not be required on pool lifts provided in spas.

1009.2.7 Operation. The lift shall be capable of unassisted operation from both the deck and water levels. Controls and operating mechanisms shall be unobstructed when the lift is in use and shall comply with Subsection 309.4.

Advisory 1009.2.7 Operation. Pool lifts must be capable of unassisted operation from both the deck and water levels. This will permit a person to call the pool lift when the pool lift is in the opposite position. It is extremely important for a person who is swimming alone to be able to call the pool lift when it is in the up position so he or she will not be stranded in the water for extended periods of time awaiting assistance. The requirement for a pool lift to be independently operable does not preclude assistance from being provided.

1009.2.8 Submerged depth. The lift shall be designed so that the seat will submerge to a water depth of 18 inches minimum below the stationary water level.



**FIGURE 1009.2.8
POOL LIFT SUBMERGED DEPTH**

1009.2.9 Lifting capacity. Single person pool lifts shall have a weight capacity of 300 pounds minimum and be capable of sustaining a static load of at least one and a half times the rated load.

Advisory 1009.2.9 Lifting capacity. Single person pool lifts must be capable of supporting a minimum weight of 300 pounds and sustaining a static load of at least one and a half times the rated load. Pool lifts should be provided that meet the needs of the population they serve. Providing a pool lift with a weight capacity greater than 300 pounds may be advisable.

1009.3 Sloped entries. Sloped entries shall comply with this Subsection.

Advisory 1009.3 Sloped entries. Personal wheelchairs and mobility devices may not be appropriate for submerging in water. Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the pool water. Providing an aquatic wheelchair made of noncorrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs or other mobility aids.

1009.3.1 Sloped entries. Sloped entries shall comply with Chapter 4 except as modified in this Subsection and Subsections 1009.3.2 and 1009.3.3.

Exception: Where sloped entries are provided, the surfaces shall not be required to be slip resistant.

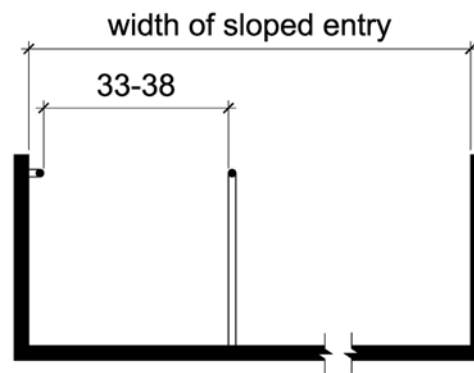
1009.3.2 Submerged depth. Sloped entries shall extend to a depth of 24 inches minimum and 30 inches maximum below the stationary water level. Where landings are required by Subsection 405.7, at least one landing shall be located 24 inches minimum and 30 inches maximum below the stationary water level.

Exception: In wading pools, the sloped entry and landings, if provided, shall extend to the deepest part of the wading pool.

1009.3.3 Handrails. At least two handrails complying with Section 505 shall be provided on the sloped entry. The clear width between required handrails shall be 33 inches minimum and 38 inches maximum.

Exceptions:

1. Handrail extensions specified by Subsection 505.10.1 shall not be required at the bottom landing serving a sloped entry.
2. Where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, the handrails shall not be required to comply with the clear width requirements of this Subsection.
3. Sloped entries in wading pools shall not be required to provide handrails complying with this Subsection. If provided, handrails on sloped entries in wading pools shall not be required to comply with Section 505.

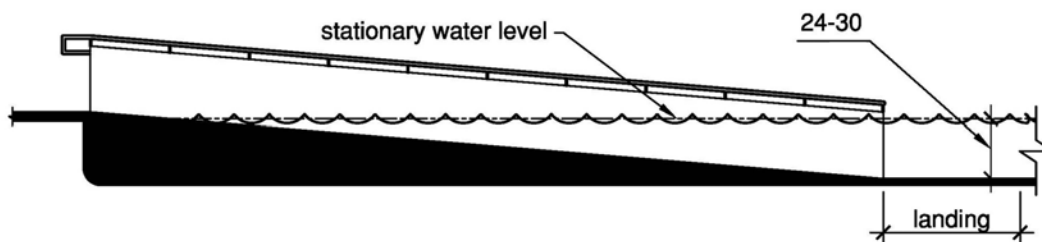


**FIGURE 1009.3.3
HANDRAILS FOR SLOPED ENTRY**

1009.4 Transfer walls. Transfer walls shall comply with this Subsection.

1009.4.1 Clear deck space. A clear deck space of 60 inches minimum by 60 inches minimum with a slope not steeper than 1:48 shall be provided at the base of the transfer wall. Where one grab bar is provided, the clear deck space shall be centered on the grab bar. Where two grab bars are provided, the clear deck space shall be centered on the clearance between the grab bars.

1009.4.2 Height. The height of the transfer wall shall be 16 inches minimum and 19 inches maximum measured from the deck.



**FIGURE 1009.3.2
SLOPED ENTRY SUBMERGED DEPTH**

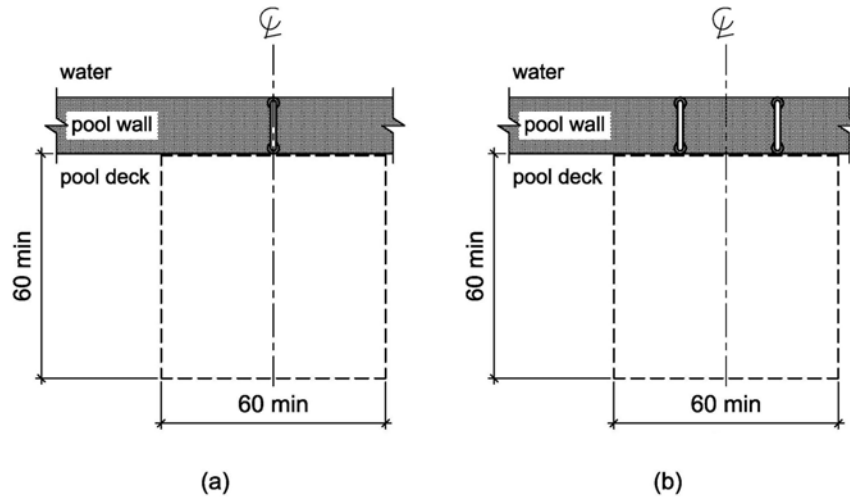


FIGURE 1009.4.1
CLEAR DECK SPACE AT TRANSFER WALLS

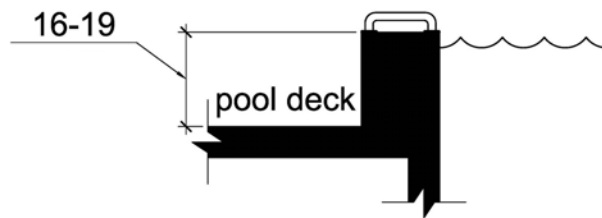


FIGURE 1009.4.2
TRANSFER WALL HEIGHT

1009.4.3 Wall depth and length. The depth of the transfer wall shall be 12 inches minimum and 16 inches maximum. The length of the transfer wall shall be 60 inches minimum and shall be centered on the clear deck space.

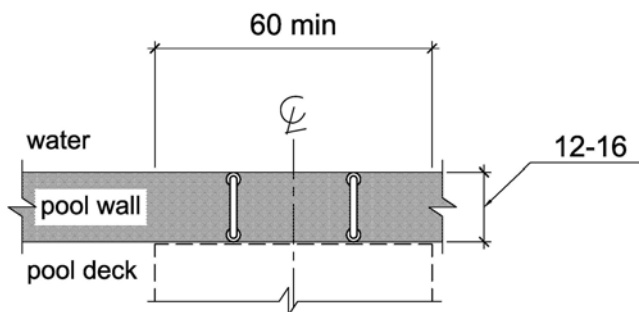


FIGURE 1009.4.3
DEPTH AND LENGTH OF TRANSFER WALLS

1009.4.4 Surface. Surfaces of transfer walls shall not be sharp and shall have rounded edges.

1009.4.5 Grab bars. At least one grab bar complying with Section 609 shall be provided on the transfer wall. Grab bars shall be perpendicular to the pool wall and shall extend the full depth of the transfer wall. The top of the gripping surface shall be 4 inches minimum and 6 inches maximum above transfer walls. Where one grab bar is provided, clearance shall be 24 inches minimum on both sides of the grab bar. Where two grab bars are provided, clearance between grab bars shall be 24 inches minimum.

Exception: Grab bars on transfer walls shall not be required to comply with Subsection 609.4.

1009.5 Transfer Systems. Transfer systems shall comply with this Subsection.

1009.5.1 Transfer platform. A transfer platform shall be provided at the head of each transfer system. Transfer platforms shall provide 19 inches minimum clear depth and 24 inches minimum clear width.

1009.5.2 Transfer space. A transfer space of 60 inches minimum by 60 inches minimum with a slope not steeper than 1:48 shall be provided at the base of the transfer platform surface and shall be centered along a 24 inch minimum side of the transfer platform. The side of the transfer platform serving the transfer space shall be unobstructed.

1009.5.3 Height. The height of the transfer platform shall comply with Subsection 1009.4.2.

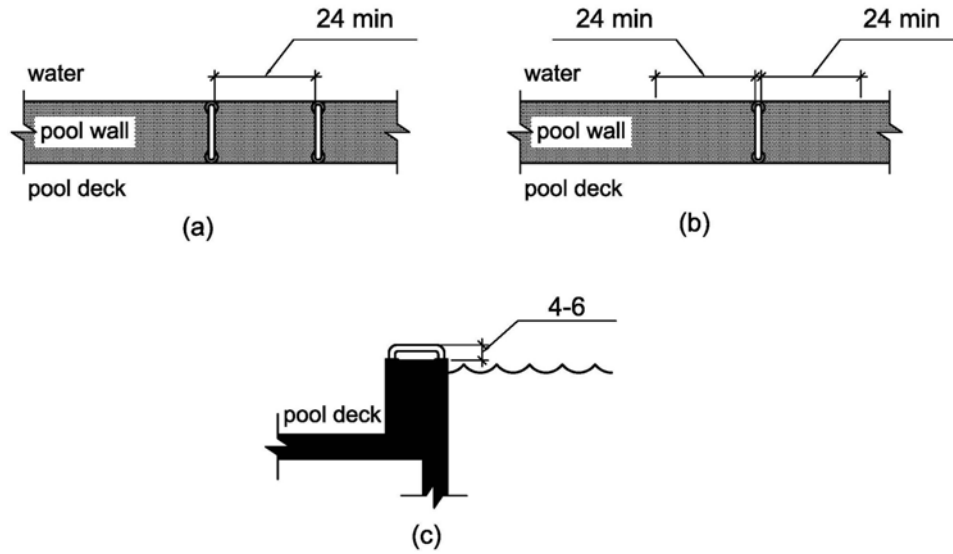


FIGURE 1009.4.5
GRAB BARS FOR TRANSFER WALLS

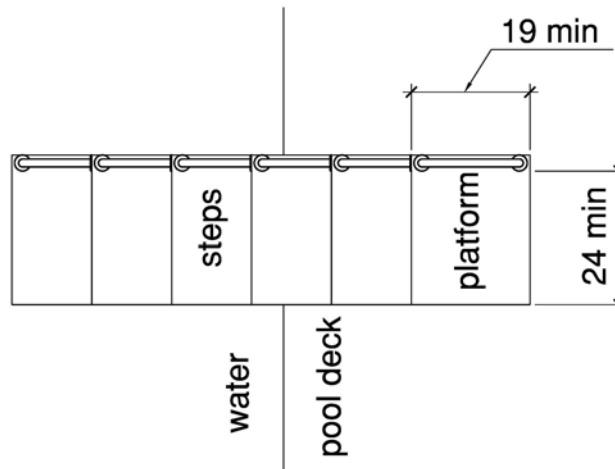


FIGURE 1009.5.1
SIZE OF TRANSFER PLATFORM

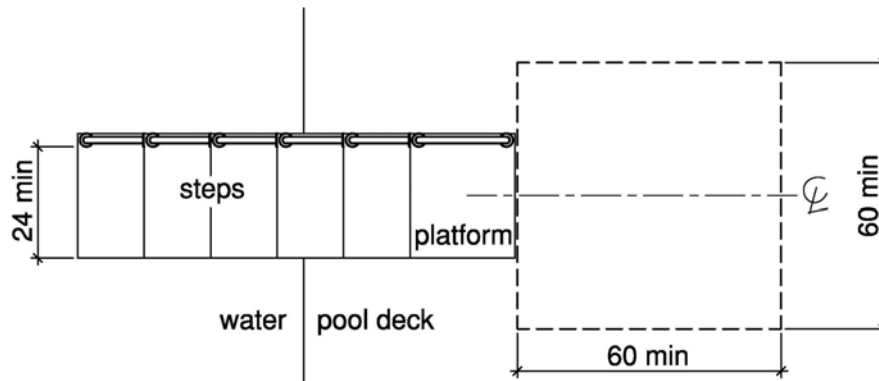
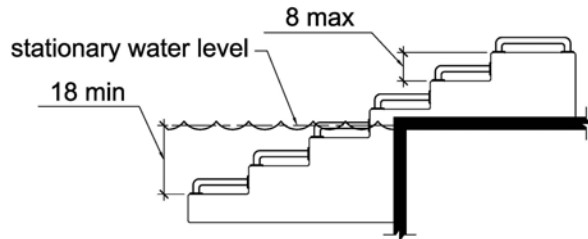


FIGURE 1009.5.2
CLEAR DECK SPACE AT TRANSFER PLATFORM

1009.5.4 Transfer Steps. Transfer step height shall be 8 inches maximum. The surface of the bottom tread shall extend to a water depth of 18 inches minimum below the stationary water level.

Advisory 1009.5.4 Transfer steps. Where possible, the height of the transfer step should be minimized to decrease the distance an individual is required to lift up or move down to reach the next step to gain access.



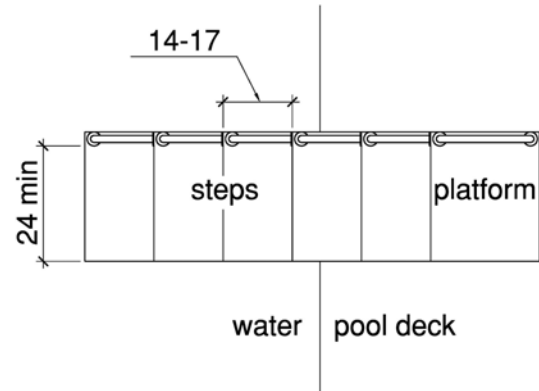
**FIGURE 1009.5.4
TRANSFER STEPS**

1009.5.5 Surface. The surface of the transfer system shall not be sharp and shall have rounded edges.

1009.5.6 Size. Each transfer step shall have a tread clear depth of 14 inches minimum and 17 inches maximum and shall have a tread clear width of 24 inches minimum.

1009.5.7 Grab bars. At least one grab bar on each transfer step and the transfer platform or a continuous grab bar serving each transfer step and the transfer platform shall be provided. Where a grab bar is provided on each step, the tops of gripping surfaces shall be 4 inches minimum and 6 inches maximum above each step and transfer platform. Where a continuous grab bar is provided, the top of the gripping surface shall be 4 inches minimum and 6 inches maximum above the step nosing and transfer platform. Grab bars shall comply with Section 609 and be located on at least one side of the transfer system. The grab bar located at the transfer platform shall not obstruct transfer.

Exception: Grab bars on transfer systems shall not be required to comply with Subsection 609.4.



**FIGURE 1009.5.6
SIZE OF TRANSFER STEPS**

1009.6 Pool stairs. Pool stairs shall comply with this Subsection.

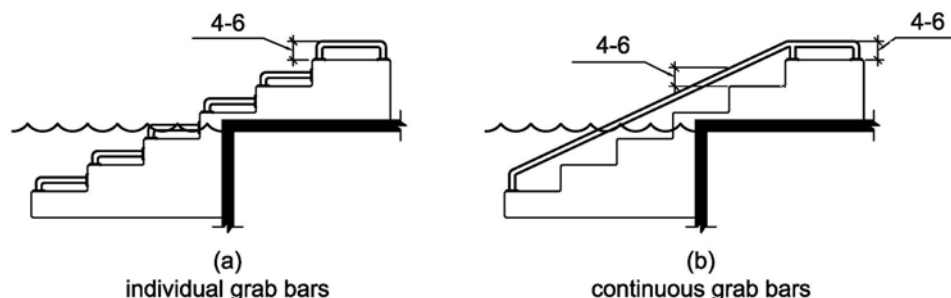
1009.6.1 Pool stairs. Pool stairs shall comply with Section 504.

Exception: Pool step riser heights shall not be required to be 4 inches high minimum and 7 inches high maximum provided that riser heights are uniform.

1009.6.2 Handrails. The width between handrails shall be 20 inches minimum and 24 inches maximum. Handrail extensions required by Subsection 505.10.3 shall not be required on pool stairs.

SECTION 1010 SHOOTING FACILITIES WITH FIRING POSITIONS

1010.1 Turning space. A circular turning space 60 inches diameter minimum with slopes not steeper than 1:48 shall be provided at shooting facilities with firing positions.



**FIGURE 1009.5.7
GRAB BARS**

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EPCOT

**BUILDING CODE
2018 EDITION**

**AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT**

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32830**

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RECOMMENDED PROCEDURES IN USING THE EPCOT BUILDING CODE

1. Determine Occupancy Classification of the structure. Select Occupancy Classification that most accurately fits the use of the building. (Chapter 5.)
2. Determine actual physical properties of building.
 - (a) Determine building area each floor. (Area definition Chapter 2.)
 - (b) Determine grade elevation for building. (Grade definition Chapter 2.)
 - (c) Determine building height in feet above grade. (Height definition Chapter 2.)
 - (d) Determine building height in stories. (Story definition Chapter 2.)
3. Determine minimum Type of Construction necessary to accommodate proposed occupancy.
 - (a) Determine maximum allowable heights and floor areas for Types of Construction and Occupancy Classification. (Table 7.5.)
 - (b) Check allowable height and area increases permitted. (Chapter 7.)
4. Check detailed Occupancy requirements. (Chapter 5.)
5. Check detailed Construction requirements.
 - (a) Fire Protection of Structural Members. (Chapter 6 and Table 6.2.)
 - (b) Fire Protection Requirements. (Chapter 7.)
 - (c) Means-of-Egress Requirements. (Chapter 8.)
6. Review design and related standards. (Appendix A.)
7. Check other requirements as necessary.
 - (a) Amusement Attractions. (EPCOT Standards 5-12 and 5-13.)
 - (b) Elevators. (EPCOT Standard 5-1.)
 - (c) Sprinklers, Standpipes and Alarm Systems. (Chapter 7.)
 - (d) Use of Combustible Materials—Interior. (Chapter 7 and Tables.)
 - (e) Roof Coverings. (EPCOT Standard 7-7.)
 - (f) Light, Ventilation and Sanitation. (Chapter 5.)

These steps are naturally varied in sequence by individual preferences; however, the first three are standard steps that should be followed in proper order to assist in the design or review of buildings.

PREFACE

The *EPCOT Building Code* is intended to promote the development of sound building construction and a safe environment for the public through accomplishing the following objectives:

- To accomplish coordinated, balanced and harmonious development in accordance with present and future needs.
- To provide the flexibility that will encourage American industry, through free enterprise, to introduce, test and demonstrate new ideas, materials and systems emerging now and in the future from the creative centers of industry.
- To provide an environment that will stimulate the best thinking of industry and the professions in the creative development of new technologies to meet the needs of people, expressed by the experience of those who live, work and visit here.
- To assure the safety, health and general welfare of the District's inhabitants, visitors and premises.
- To establish a sound, safe and forward-looking basis for developing and maintaining the District and its properties.
- To provide safety and good practice during construction, alteration, removal or demolition of buildings and structures within the district by establishing uniform, modern and progressive standards, rules and regulations.
- To regulate the quality of materials and systems for all buildings and structures within the District, including their design, construction, occupancy, location and maintenance.

This preface to the EPCOT Codes was written by Marty Sklar, a Walt Disney Imagineering legend, after he had met with Walt Disney, and shortly before Walt's untimely death. The meeting included an in-depth discussion about Walt's vision for EPCOT.

HOW TO USE THE EPCOT BUILDING CODE

For ease of reference and use, this Code is divided into standard code categories. Insofar as practical, all detailed information and requirements concerning a specific subject appear together, cross referenced to relate requirements in other sections. The plan of numbering the Code is as follows:

Chapters are designated by Arabic numerals as:

CHAPTER 1 TITLE, VALIDITY, SCOPE AND ORGANIZATION

Sections are designated by Arabic whole numbers and capital letters, as:

SECTION 103 SCOPE

Subsections are designated by Arabic decimalized numbers and small capital letter description as:

103.1 Application. Paragraphs and subparagraphs are designated by lower-case letters of Arabic numbers, in parentheses as appropriate.

A Table of Contents of chapters and sections appears in the front of the book. A detailed Index by subject, section and subsection appears in the back of the book.

Marginal Markings

Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the 2015 edition. Deletion indicators in the form of an arrow (➡) are provided in the margin where an entire section, paragraph, exception or table has been deleted, or an item in a list of items or a table has been deleted.

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CHAPTER 1

TITLE, VALIDITY, SCOPE AND ORGANIZATION

SECTION 101 TITLE

101.1 Title. The provisions in the following chapters and sections of this volume, together with the appendices, shall constitute and be known as “The *EPCOT Building Code*,” hereinafter referred to as “this Code.”

101.2 Referenced standards. Standards referred to throughout this Code as “EPCOT Standard” followed by a number, are listed in Appendix A and these standards are hereby declared to be a part of this Code.

101.3 Fire limits. The requirements for Fire Limits in the Reedy Creek Improvement District (the District) are set forth in Appendix B and these requirements are hereby declared to be a part of this Code.

101.4 Definitions. For the purpose of this Code, certain abbreviations, terms, phrases, words and their derivations shall be construed as specified in Chapter 2, and these definitions are hereby declared to be a part of this Code.

101.5 Validity. If any section, subsection, sentence, clause or phrase of this Code is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining parts of this Code.

SECTION 102 PURPOSE

102.1 Purpose. The purpose of this Code, is to provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all buildings and structures within the District and certain equipment specifically regulated herein.

SECTION 103 SCOPE

103.1 Applicability.

103.1.1 General. Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

103.1.2 Building. The provisions of this Code shall apply to the construction, alteration, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures within the jurisdiction of the District.

103.1.3 Electrical. The provisions of the *EPCOT Electrical Code* shall apply to the installation of electrical systems,

including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and appurtenances thereto.

103.1.4 Gas. The provisions of the *EPCOT Fuel Gas Code* shall apply to the installation of consumers’ gas piping, gas appliances and related accessories as covered in this Code. These requirements apply to gas piping systems extending from the point of delivery to the inlet connections of appliances, and the installation and operation of residential and commercial gas appliances and related accessories.

103.1.5 Mechanical. The provisions of the *EPCOT Mechanical Code* shall apply to the installation of mechanical systems, including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and/or appurtenances, including ventilating, heating, cooling, air-conditioning and refrigeration systems, incinerators, and other energy-related systems.

103.1.6 Plumbing. The provisions of the *EPCOT Plumbing Code* shall apply to every plumbing installation, including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and appurtenances, and when connected to a water or sewerage system and all aspects of a medical gas system.

103.1.7 Energy. The provisions of the *EPCOT Energy Efficiency Code for Building Construction* shall apply to all new buildings and manufactured homes, additions to existing buildings and manufactured homes and renovations to existing buildings. These requirements shall apply to site-installed building components and to the installation or replacement of building systems and building components.

103.1.8 Accessibility. The provisions of the *EPCOT Accessibility Code for Building Construction* shall apply to all new or altered buildings that may be frequented in, lived in or worked in by the public for which a permit is required under Section 301.

103.1.9 Referenced standards. Standards referenced in the technical codes shall be considered an integral part of the codes without separate adoption. If specific portions of a standard are denoted by code text, only those portions of the standard shall be enforced. Where code provisions conflict with a standard, the code provisions shall be enforced. Permissive and advisory provisions in a standard shall not be construed as mandatory.

103.2 Additions, alterations and repairs. Additions, alterations, repairs and changes of use or occupancy in all buildings and structures shall comply with the provisions for new buildings and structures, except as otherwise provided in this Section and Subsection 302.6.

103.3 Moved buildings. Buildings and structures moved into or within the District shall comply with the provisions of this Code for new buildings.

SECTION 104 ORGANIZATION

104.1 Creation of building department. There is hereby created in the District the Department of Building and Safety, which shall be under the direction of the Manager of Building and Safety, who shall also bear the title of Building Official.

104.2 Appointment of Building Official. The Chief Appointing Authority of the District shall appoint a Building Official. Such person shall have not less than 10 years experience, either as a professional engineer, registered architect, building official or superintendent of construction, for five years of which he shall have been in responsible charge of work.

104.3 Delegation of authority. The Building Official shall have the power to delegate powers and assignments to subordinate employees working under his authority. Such employees shall have the duties and powers as delegated by the Building Official.

104.4 Reports and records.

- (a) The Building Official shall submit a report to the Appointing Authority of the District, not less than once a year, covering the work of the department during the preceding period. He shall incorporate in said report a summary of his recommendations of desirable amendments to this Code.
- (b) The Building Official shall keep a permanent record, accurate account of all fees and other monies collected and received under this Code, the names of the persons on whose account the same were paid, the date and amount thereof, together with the location of the building or premises to which they relate.

104.5 Right of entry.

- (a) Whenever necessary to make an inspection to enforce any of the provisions of this Code, or whenever the Building Official or his authorized representative has reason to believe that there exists in any building or upon any premises a condition that makes such building or premises unsafe as defined in Section 310, the Building Official or his authorized representative may enter such building or premises at reasonable times to inspect the same, or to perform any duty imposed on the Building Official by this Code; provided that if such building or premises be occupied, he shall first present proper credentials and request entry; and if such building or premises be unoccupied, he shall first make a reasonable effort to locate the owner or other persons having charge or control of the building or premises and request entry. If such entry is refused, the Building Official or his authorized representative shall have recourse to remedy provided by law to secure entry.
- (b) No owner, occupant or other person having charge, care or control of any building or premises shall fail or neglect, after proper request made as herein provided, to permit entry therein by the Building Official or his authorized representative for the purpose of inspection and examination as provided by this Code. Any person violating this Subsection shall be guilty of a misde-

meanor as provided under Section 67 of Chapter 67-764, Laws of Florida, Special Acts of 1967.

104.6 Stop work orders. Whenever any building work is being done contrary to provisions of this Code, or is being done in an unsafe or dangerous manner, the Building Official may order such work stopped, or may order the violation corrected by notice in writing served on the person(s) engaged in doing or causing such work to be done; and such persons shall immediately stop the work until authorized by the Building Official to proceed.

104.7 Unlawful occupancy. Whenever any building or part thereof is being used or occupied contrary to the provisions of this Code, the Building Official shall order such use or occupancy discontinued and the building or part thereof vacated. Such order shall be in writing, served on the person(s) using or causing to be used, such building or parts thereof. Within a 30-day period after receipt of notice or order, such building or part thereof shall be made to comply with the requirements of this Code; however, in the event of an emergency, Subsections 310.5 and 310.7 shall apply.

104.8 Concealed work. The Building Official may order parts of the structural frame of any building or structure to be exposed for inspection when, in his opinion, the building or part thereof is in an unsafe or dangerous condition, or when there is willful or negligent concealment of a violation of this Code.

104.9 Requirements not covered by code. Any requirement necessary for the strength or stability of any existing or proposed building or structure, or for the safety or health of the occupants thereof, not specifically covered by this Code, shall be determined by the Building Official, subject to the Board of Appeals.

SECTION 105 OTHER REGULATORY AGENCIES

105.1 Approvals by other agencies having jurisdiction. The Building Official shall require that the laws, rules and regulations of all other regulatory agencies having jurisdiction shall be met before a building permit is issued to an applicant. The Building Official shall require evidence in writing to show that other regulatory agencies having jurisdiction over the design, construction, alteration, repair, equipment, maintenance, and relocation of buildings and structures in the District, have approved the proposed construction. The Building Official shall not be held responsible for enforcement of the regulations of such other regulatory agencies unless he is specifically authorized to enforce that agency's regulations.

SECTION 106 BOARD OF APPEALS

106.1 Creation of Board of Appeals.

- (a) There is hereby established a Board to be designated the Board of Appeals, consisting of five members qualified by training and experience to rule on matters relating to building, who shall be appointed by the

Chief Appointing Authority of the District. A majority of the members shall be professional engineers or registered architects. The Board shall select one of its members to serve as chairman, and the Building Official shall be an ex officio member without vote and shall act as Secretary to the Board.

- (b) Whenever the Building Official shall reject or refuse to approve the manner of proposed construction, and to assist in determining the suitability of alternative materials and methods of construction, the owner of such building or structure or his duly authorized agent may appeal from the decision of the Building Official to the Board of Appeals.

106.2 Term of office. The Chief Appointing Authority of the District shall appoint one member of the Board of Appeals for a term of one year, two members for a term of two years and two members for a term of three years; and thereafter, they shall be appointed for a term of three years. Vacancies shall be filled for an unexpired term by the Chief Appointing Authority. Absence of a member from three consecutive meetings of the Board, unless excused, shall render such member liable to immediate removal from office by the Chief Appointing Authority.

106.3 Quorum. Four members of the Board of Appeals shall constitute a quorum. In varying the application of any provision of this Code, or in modifying an order of the Building Official, a majority vote shall be required.

106.4 Meetings and records. Meetings of the Board shall be held at the call of the chairman and at such other times as the Board may determine. All hearings before the Board shall be open to the public. The Board shall keep minutes of its proceedings, showing the vote of each member on every question, or if the member is absent or fails to vote, indicating such facts. The Board shall also keep records of its examinations and other official actions. Minutes and records of the Board shall be public records.

106.5 Procedures. The Board shall establish rules and regulations for its own procedures consistent with the provisions of this Code.

106.6 Appeals. An appeal may be made within 30 days from the date of the decision appealed by filing with the Building Official and the Board of Appeals a notice of appeal, specifying the grounds thereof. In the case of a building or structure that, in the opinion of the Building Official, is unsafe or dangerous, the Building Official may limit the time for such appeal to a shorter period. The Building Official shall forthwith transmit to the Board all the papers on which action appealed from was taken and shall schedule a public hearing thereon.

106.7 Modifications and variations.

- (a) When appealed to and after such public hearing, the Board may vary the application of any provision of this Code to any particular case when in the opinion of the Board:
 - 1. The enforcement thereof would constitute an injustice and would be contrary to the purpose of this Code or to the public interest; or
 - 2. A variance is required to modify, amend or reverse the interpretation of the Building Official.
- (b) The Board may grant variances to this Code to encourage the development of a new art and science of building design and construction, and the use of new materials in new applications.
- (c) A decision of the Board to vary the application of any provision of this Code, or to modify an order of the Building Official, shall be in writing and shall specify the manner in which such variation or modification is made, the conditions upon which it is made and the reasons therefore.

106.8 Decisions.

- (a) In every case, the Board shall reach a decision without unreasonable or unnecessary delay. Every decision of the Board shall be entered in the minutes of such meeting. Every decision shall be promptly filed in the office of the Building Official and shall be open for public inspection. A certified copy shall be sent by mail or messenger to the appellant and a copy shall be publicly posted in the office of the Building Official for two weeks after filing. The decision of the Board shall be final, subject to such remedy as any aggrieved party might have at law or in equity.
- (b) If a decision of the Board reverses or modifies a refusal order or disallowance of the Building Official, or varies the application of any provision of this Code, the Building Official shall take action immediately in accordance with such decision.

SECTION 107 LIABILITY

107.1 Liability.

- (a) Any officer or employee, or member of the Board of Appeals, charged with the enforcement or interpretation of this Code, acting for the applicable governing body in the discharge of his duties, shall not thereby render himself personally liable, and he is relieved from all personal liability for any damage that may accrue to persons or property as a result of any act required or permitted in the discharge of his duties. Any suit brought against any officer or employee because of such act performed by him in the enforcement of any provision of this Code shall be defended by the legal counsel of the District until the termination of the proceedings.
- (b) This Code shall not be construed to relieve from or lessen the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall the code enforcement agency or its parent jurisdiction be held as assuming any such liability by reason of the inspections authorized by this Code or any permits or certificates issued under this Code.

SECTION 108 VIOLATIONS AND PENALTIES

108.1 Violations and penalties. Any person, firm, corporation or agent who shall violate a provision of this Code, or fail to comply therewith, or with any of the requirements thereof, or who shall erect, construct, alter, demolish or relocate any structure, or has erected, constructed, altered, repaired, relocated or demolished a building or structure in violation of a detailed statement or drawing submitted and approved thereunder, shall be guilty of a misdemeanor as provided under Section 67 of Chapter 67-764, Laws of Florida, Special Acts of 1967.

CHAPTER 2

DEFINITIONS

SECTION 201 GENERAL

201.1 Purpose. The abbreviations, terms, words and their derivatives defined herein shall be construed as specified in this Chapter in applying the provisions of this Code. Definitions of technical terms relating to a specific subject appearing in other Chapters are referenced herein to the Chapter and Section in which they appear.

201.2 Scope.

- (a) Words used in the present tense include the future tense; words used in the masculine gender include the feminine and neuter genders; the singular includes the plural and the plural includes the singular.
- (b) Where terms are not defined or the definition herein is supplementary, terms shall have the meaning given in *Merriam-Webster's Tenth New Collegiate Dictionary*, as revised.
- (c) Terms relating to the fire-resistive qualities of building materials and assemblies of materials shall have the meaning specified in ASTM E176 entitled "*Terms Related to Fire Tests of Building Construction Materials*."

SECTION 202 DEFINITIONS

ACCEPTED ENGINEERING PRACTICE. Practice conforming to the accepted principles, tests or standards of nationally recognized technical or scientific authorities, as determined by the Building Official.

ACCESSORY BUILDING. See Group S, Satellite Occupancies, Section 516.

AGRICULTURAL BUILDING. Building located on agricultural property used for sheltering farm implements, hay, grain, livestock, or other farm produce or equipment in which there is not human habitation and that is not used by the public.

ALLEY. Public space or thoroughfare less than 20 feet wide, but not less than 10 feet wide that has been deeded or dedicated to the public for permanent public use.

ALTER OR ALTERATION. Change, addition or modification in the construction, installation or occupancy of a building.

ANSI. American National Standards Institute. Formerly, the United States of America Standards Association.

APARTMENT. Room or suite of rooms that is occupied or intended to be occupied or that is designed to be occupied by one family (q.v.) for living and sleeping.

APARTMENT HOUSE. Building or part thereof designed, built, rented or leased to be occupied, or that is being occupied as the home or residence of more than three families living independently of each other and doing their own cooking in the housekeeping and unit they occupy.

APPROVED. As applied to a material, device or method of construction, means approved by the Building Official in accordance with the provisions of this Code.

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or supplying inspection services, when such agency has been approved by the Building Official.

ARCADE. Passageway roof over and enclosed, with egress at the ends and serving as a common entrance and exit for buildings located thereon.

ARCHITECT OR REGISTERED ARCHITECT. Person qualified and licensed by the State of Florida to practice architecture.

AREA. As applied to a building or structure, the usable area, in square feet, under the horizontal projection of the roof or floor above.

AREA, GROSS FLOOR. The area within the inside perimeter of the exterior walls with no deduction for corridors, stairs, closets, thickness of walls, columns or other features, exclusive of areas open and unobstructed to the sky.

AREA, NET FLOOR. The area actually occupied not including accessory unoccupied areas, such as corridors, stairs, closets, thickness of walls, columns, toilet rooms, mechanical areas or other features.

AREA OF REFUGE. An area with direct access to an exit where persons unable to use stairs can remain temporarily in safety to await instructions or assistance during emergency evacuation.

AREAWAY. Unroofed surface adjacent to a building.

ASSEMBLY BUILDING. See Subsection 504.1.

ASTM. ASTM International. Formerly, the American Society for Testing and Materials.

ATRIUM. A space, intended for occupancy within a building, extending vertically through the building and enclosed at the top.

ATTIC OR ATTIC STORY. Space between the ceiling beams of the top habitable story and the roof rafters that may be used for storage or habitation.

AUTOMATIC. As applied to a fire door or other opening protective, means normally held in an open position and automatically closed by a releasing device activated by excessive heat, smoke or a predetermined rate of rise in temperature.

AUTOMATIC FIRE-EXTINGUISHING SYSTEM. Definitions pertaining to fire-extinguishing systems and standpipes appear in Section 715.

BALCONY. Seating space of an assembly area, the lowest part of which is raised 4 feet or more above the level of the main floor.

DEFINITIONS

BASEMENT. Story of a building between floor and ceiling, partly below and partly above grade, located so that the vertical distance from grade to the floor below is less than the vertical distance from grade to ceiling. (See “Story.”)

BAY WINDOW. Window supported on a foundation extending beyond the main walls of a building.

BOILER. See the *EPCOT Mechanical Code*.

BOILER ROOM. Any room with a boiler.

BUILDING. Structure built for support, shelter, enclosure or use of persons, animals, chattels or property of any kind.

BUILDING, EXISTING. A building erected prior to adoption of this Code, or one for which a legal permit has been issued.

BUILDING LINE. The line established by law beyond which a building shall not extend, except as specifically provided by law.

BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this Code, or duly authorized representative by the Building Official.

BUILDING, PUBLIC. See “Public building.”

BUILDING, UNSAFE. See “Unsafe building.”

BULKHEAD.

- (a) Exterior walls of a store building that support show windows.
- (b) Structure above the roof of a building, enclosing elevator machinery, tanks, stairs or the like, or the part of a shaft extending above the roof.
- (c) Retaining structure intended to withstand lateral pressure.

CANOPY. Any fixed roof-like structure, which is self-supporting in whole or in part, but having no sidewalls or curtains other than valances not exceeding 18 inches in depth.

CART. A mobile unit that is easily moveable by no more than two persons and may require some disassembly prior to transport or storage.

CAST STONE. Precast building stone manufactured from Portland cement concrete, used as trim, veneer or facing on or in a building.

CELLAR. See “Basement.”

CHIMNEY. Vertical structure containing one or more flues used to remove hot gases from combustion or from industrial processes. For classification of chimneys, see the *EPCOT Mechanical Code*.

CONCRETE. Mixture of Portland cement, aggregates and water. (See additional definitions in EPCOT Standard 1003-1.)

CONCRETE, PLAIN. Concrete without reinforcement.

CONCRETE, REINFORCED. Concrete in which reinforcement other than that provided for shrinkage or temperature change is embedded in such a manner that the two materials act together in resisting forces.

CONSTRUCTION. Work or operations necessary or incidental to land clearing, grading, excavation and filling; or

erection, demolition, assembling, installing or equipping of buildings or structures; or alterations incidental thereto, or to the finished product of construction operations.

CONTRACTOR. One who contracts on predetermined terms to provide labor and materials and to be responsible for performance of a construction job in accordance with established plans and specifications.

CORRIDOR. An enclosed exit access component that defines and provides a path of egress travel.

CORRIDOR, PRIVATE. Any corridor other than a public corridor.

CORRIDOR, PUBLIC. Corridor open to general or common use by the public.

COURT. An open, uncovered, unoccupied space on the same property as a building. An inner court is any court other than an outer court or yard. An outer court other than a yard (q.v.) having at least one side open to a street, alley, yard or other permanent open space.

DEAD LOAD. See “Load, dead.”

DEMOLITION. Dismantling or razing of all or part of a building and all operations incidental thereto.

DISPLAY SIGN. Structure arranged, intended or designed as an advertisement, announcement or direction; includes signs, sign screens, billboards and advertising devices of all kinds.

DOOR ASSEMBLY. See “Fire door.”

DORMITORY. Room in other than a Group R-3 occupancy having separate sleeping accommodations for more than three persons.

DRAFTSTOP. See “Firestop.”

DUMBWAITER. See ANSI A17.1.

DWELLING. Building occupied exclusively for residential use having not more than two dwelling units.

DWELLING UNIT. One or more rooms arranged for the use of one or more persons as a single housekeeping unit, with facilities for cooking, living and sleeping and with sanitary facilities as required in the *EPCOT Plumbing Code*.

ELEVATOR. See EPCOT Standard 5-1.

ENGINEER OR REGISTERED ENGINEER. Person qualified and licensed by the State of Florida to practice the profession of engineering.

ESCALATOR. See EPCOT Standard 5-1.

EXISTING BUILDING. See “Building, existing.”

EXIT. For definitions pertaining to means of egress, see Subsection 801.4.

FAMILY. Two or more persons living as a single housekeeping unit, including persons related by blood, marriage or adoption and domiciled servants, but not paying guests.

FENCE. Freestanding wall, a balustrade or a railing 3 feet or more high, erected to divide property, to serve as a barrier or guard, or for decoration.

FIRE DIVISION WALL. See “Wall, fire division wall.”

FIRE DOOR. A door and its assembly constructed and assembled in place to give protection against the passage of fire, complying with the requirements of Chapter 7.

FIRE PARTITION. A vertical assembly of materials designed to restrict the spread of fire in which openings are protected.

FIRE-RESISTIVE CONSTRUCTION. See Chapter 6.

FIRE-RESISTIVE RATING. Time, in hours, that a material or construction will withstand fire exposure as determined by a fire test made in conformity to EPCOT Standard 6-1.

FIRE-RETARDANT-TREATED WOOD. See EPCOT Standard 1010-9.901.

FIRE WALL. See “Wall, fire division wall.”

FIRE WINDOW. Window and its assembly, constructed and assembled in place to give protection against the passage of fire and complying with the requirements of Chapter 7.

FIRESTOP. A solid, tight enclosure placed to restrict the spread of fire and smoke in attics, under and between floors, and in other concealed places.

FLOOR AREA. Area included within the surrounding exterior walls of a building or part thereof, exclusive of vent shafts and courts. The floor area of a building or part thereof not having surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above.

FOOTING. Part of the foundation of a structure that spreads and transmits the load direct to the soil or to piles.

FOYER. Area or space within a building, located between the main entrance and the occupied areas of a building. When used in connection with a theater, the area between the lobby and the main floor.

GALLERY. That part of the seating area of a theater or assembly room located above a balcony and having a seating capacity of more than 10.

GARAGE. Building, other than open carport structure, or part thereof in which a motor vehicle, containing a flammable liquid in its fuel storage tank, is stored, housed, kept, repaired or serviced.

Automotive Service Garage. Garage where no repair work is done, except the exchange of parts and maintenance requiring no open flame, cutting, welding or use of highly flammable liquids.

Basement Parking Garage. Parking garage having exterior walls around more than 50 percent of the perimeter.

Enclosed Parking Garage. Parking garage having exterior walls around more than 50 percent of the perimeter.

Mechanical Access Garage. See Subsection 508.5.

Open-Air Parking Garage. Garage having at least 50 percent of the perimeter open to the air at each story.

Parking Garage. Garage used solely for parking motor vehicles.

Private Garage. A building or part thereof not more than 1,000 square feet in area, in which only motor vehicles

used by the owner or tenants of the building are stored or kept.

Ramp, Access Garage. See Subsection 508.5.

Repair Garage. Garage where major repairs can be made to three or more motor vehicles at the same time.

GRADE (GROUND LEVEL). Average of the finished ground level at the center of all walls of a building. Where walls are parallel to and within 5 feet of a sidewalk, the ground level shall be measured at the sidewalk.

GRADE (LUMBER). Classification of solid sawn lumber with respect of strength, quality, mechanical properties and use.

GROUND FLOOR. Floor of a building located not more than 2 feet below, nor more than 6 feet above, grade.

GUARDRAIL. A safety method to prevent people or objects from falling from elevated walking surfaces or stairs.

GUEST. Person hiring or occupying a room for living or sleeping, not included in a family as defined herein.

GUEST ROOM. A room that is used, rented or hired out to be occupied for sleeping purposes.

HABITABLE ROOMS. Room in a residential occupancy used for living, sleeping, cooking and eating, but excluding bath, storage and service area, and corridors.

HANDRAIL. A railing provided for grasping with the hand for support.

HARDWARE, PANIC. See Subsection 801.4.

HEIGHT OF BUILDING. Vertical distance from the grade (q.v.) to the highest point of the coping of a flat roof or to the deck line of a mansard roof or to the average height of the highest gable of a pitch or hip roof. (See “Story.”)

HEIGHT, STORY. Vertical distance from top to top of two successive tiers of floor beams or finished floor surfaces.

HEIGHT, WALL. Vertical distance from the top measured from the foundation wall or from a girder or other immediate support of such wall.

HELIPORT. Area of land or structural surface used or intended to be used for maintenance, refueling, landing and take-off of helicopters, and any appurtenant areas used or intended to be used for heliport buildings and facilities.

HELISTOP. Same as Heliport, except that no refueling, maintenance, repair or storage of helicopters is permitted.

HORIZONTAL EXIT. See Subsection 801.4.

HORIZONTAL SEPARATION. Permanent open space between a building wall and the lot line or the centerline of a facing street, alley or public way. Where two or more buildings are located on the same lot, the horizontal separation of the wall shall be measured from an imaginary line drawn at a distance from the facing wall equal to the horizontal separation applicable for that wall.

HOTEL. Building having facilities accommodating four or more transient guests with rooms intended or designed to be rented or used for sleeping.

DEFINITIONS

JURISDICTION. Legally constituted authority that has adopted this Code by law or ordinance.

KIOSK. A kiosk is defined as a small structure, no larger than 200 square feet, which may be portable through more extensive disassembly, but is primarily intended as permanent. It may be constructed on- or off-site, then anchored and connected to utilities as permanent.

LIQUID PROPANE. Propane that has been liquefied. For purposes of this Code, LP fuel is considered a gas.

LOAD, DEAD. The weight of the walls, permanent partitions, framing, floors, roofs and all other permanent stationary construction entering into and becoming a part of the building.

LOAD, LIVE. Weight superimposed by the use and occupancy of the building or structure, not including the wind load, dynamic load or dead load.

LOBBY. Enclosed vestibule directly accessible from the main entrance of a theater, hotel, apartment house or similar building with an occupant load of 10 or more.

LODGING HOUSE. Building or part thereof with accommodations for not more than four guests where rent is paid in money, goods or labor. A lodging house shall comply with the requirements of this Code for Group R-2 occupancies.

LOT. Smallest parcel of land considered as a unit.

LOT LINE. Line dividing one lot from another, or from a street or other public space.

LP FUEL. Liquid propane.

MALL. Definitions pertaining to mall, covered walkways and tunneled walkways appear in Subsection I-101.2.

MARQUEE. Permanent roofed structure attached to and supported by a building. Human occupancy is prohibited, except for service of equipment.

MASONRY. Built-up unit of construction or combination of materials, such as clay, shale, concrete, glass, gypsum, tile or stone, set in mortar. (For definitions of masonry classifications and special subjects, see EPCOT Standard 1006-2.)

MEZZANINE OR MEZZANINE FLOOR. Intermediate floor placed in a room or story of a building. When the total area of a mezzanine is more than $33\frac{1}{3}$ percent of the total floor area of the room or floor, it shall be considered as an additional story.

MOBILE FOOD DISPENSING VEHICLE. A vehicle mounted public food service establishment, self-propelled or otherwise moveable from place to place. Such vehicles must be self-sufficient for utilities. Each mobile food dispensing vehicle is required to have a State approved commissary that it reports to at least once a week.

NOMINAL DIMENSION. Commercial size width and thickness in standard solid sawn lumber and glued-laminated lumber designated by the lumber industry; somewhat larger than standard net size of dressed lumber.

NONCOMBUSTIBLE MATERIAL. A material that complies with any one of the following shall be considered a non-combustible material:

- (a) The material, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat;
- (b) The material is reported as passing ASTM E136;
- (c) The material is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652.

Exception: Inherently noncombustible materials such as steel, concrete, masonry, glass, etc., are not required to be tested in order to be classified as non-combustible materials.

NONCONFORMING. Building or structure that does not conform to the requirements of this Code, its Standards, Appendices or Amendments.

OCCUPANCY. The use or intended use of a building, or the building or part of the building housing such use.

OCCUPANT LOAD. See Subsection 801.4.

OWNER. The owner of a building or structure or his duly authorized agent or attorney, a purchaser, devisee, fiduciary and a person having a vested interest in the property.

PANIC HARDWARE. See Subsection 801.4.

PARAPET. That part of a wall entirely above the roof line.

PARTITION. An interior wall that subdivides spaces within a story, or the attic or basement of a building. A partition may be permanent or temporary.

PARTITION, PARTIAL. A partition with a maximum height of 72 inches.

PASSENGER ELEVATOR. See "Elevator."

PENTHOUSE. Enclosed structure other than a roof structure (q.v.) located on a roof, extending not more than 12 feet above a roof. (See "Story.")

PERMIT. Written authorization by the Building Official to proceed with construction, alteration, repair, installation, removal or demolition of a building; or with plumbing, electrical, gas or mechanical work.

PERSON. A natural person, his heirs, executors, administrators or assigns; including a firm, partnership or corporation, or their successors, or assigns or the agent of any of the entities named herein.

PLACE OF ASSEMBLY. Room or space used for assembly of 50 or more persons. (See Subsection 504.1.)

PLASTIC. Material containing as an essential ingredient an organic substance of large molecular weight, is solid in its finished state and, at some stage in its manufacture or in its processing into finished articles, can be shaped by flow.

PLATFORM. That raised area within a building used for the presentation of music, plays or other entertainment, the head table for special guests, the raised area for lectures and speakers, boxing and wrestling rings, theater-in-the-round and similar purpose wherein there are no overhead hanging curtains, drops, scenery or stage effects other than lighting.

PLATFORM, PERFORMANCE OR EVENT. An area within or exterior to a building used for entertainment or presentation wherein there are limited combustible material or finishes, which is erected on a temporary basis not to exceed 90 days.

PREFABRICATED. Fabricated prior to erection or installation on or in a building or on a foundation.

PRIVATE STAIRWAY. See Subsection 801.4.

PUBLIC BUILDING. Building or part of a building that is open to public access as described in the *EPCOT Accessibility Code for Building Construction*.

PUBLIC SPACE. Open spaces dedicated for public use such as public parks, rights-of-way, waterways, public beach, and other permanently unobstructed yards or courts having access to a street as required in Chapter 5.

PUBLIC WAY. See Subsection 801.4.

RATPROOFING. Impervious to rodent infestation and propagation.

REINFORCED CONCRETE. See “Concrete, reinforced.”

REPAIR. Replacement or renewal of any part of an existing building with equivalent materials for the purpose of its maintenance, excluding addition, change or modification as defined in Alteration (q.v.).

REPAIR GARAGE. See “Garage.”

REQUIRED. Required by this Code, the EPCOT Standards or the Appendices.

RESIDENTIAL OCCUPANCY. See Sections 513 to 515.

ROOF STRUCTURE. Structure above the roof of any part of a building enclosing a stairway, tank, elevator machinery, service equipment or part of a shaft extending above the roof, not housing living or recreational accommodations.

SAFE DISPERSAL AREA. See Subsection 817.2.

SEATING CAPACITY. As determined by Subsection 802.1 and Table 8.1.

SELF-CLOSING. As applied to a fire door or other opening protective, means normally closed and equipped with an approved device that will ensure closing after having been opened for use.

SEPARATION, HORIZONTAL. See “Horizontal separation.”

SHADE STRUCTURE. A free-standing structure open on all sides that is primarily intended for use by occupants for protection from the elements and not used for merchandising, retail, storage or other nonapproved uses, with a minimum separation of 15 feet to the nearest building or structure.

SHAFT. Vertical opening or passage through two or more floors of a building or through floors and roof.

SHALL. Where used in this Code, shall is mandatory.

SHED. A manufactured or site-built building not exceeding 200 square feet in size and is used only for storage.

SIGN. See Appendix D.

SMOKE BARRIER. A continuous membrane, or a membrane with discontinuities created by protected openings, where such membrane is designed and constructed to restrict the movement of smoke.

SOLID MASONRY. See “Masonry.”

STAGE. Partly enclosed portion of an assembly building, designed or used for presentation of plays, demonstrations or other entertainment, wherein scenery, drops or other effects may be installed or used, and where the distance between the top of the proscenium opening and the ceiling above the stage is more than 5 feet. (See “Platform.”)

STAIRWAY. One or more flights of stairs and the landings and platforms connecting them, forming a continuous and uninterrupted passage from one level to another in a building or structure. Two or more risers shall constitute a flight of stairs.

STAND. See Subsection 817.2.

STANDPIPE. See Subsection 715.2.

STORY. Part of a building between a floor and the next floor or roof above. A mezzanine shall be considered a story when it exceeds 33⅓ percent of the area of the floor immediately below. A penthouse shall be considered a story when it exceeds 1,000 square feet or 33⅓ percent of the roof area. A basement used for human occupancy shall be considered a story.

STREET. Thoroughfare more than 20 feet wide that has been legally dedicated or deeded to public use.

STREET LINE. A lot line dividing a lot from a street.

STRUCTURAL ELEMENTS. See Subsection 702.1.

STRUCTURAL FRAME. Frame composed of individual members of a building or structure required to transmit loads to the ground.

STRUCTURAL MEMBERS. Members that transmit loads to the ground.

STRUCTURE. Combination of materials forming a construction regulated by this Code.

STUDIO. Motion picture and television soundstages. (See Appendix M.)

SUITE. A group of rooms occupied as a unit.

TANK. A structure, above grade, that encloses a volume that either holds bulk solids or liquids, or simulates that.

TEMPORARY. Intended for use for a period not exceeding 90 days. (For Trailers, see Appendix J.)

TOWER. A structure, above grade, which may or may not have access by people, having emphasis on the vertical. It may function as a support, antenna or decoration.

DEFINITIONS

TYPE OF CONSTRUCTION. Combination of materials used in the construction of a building or structure, based on the varying degrees of fire resistance, as specified in Subsection 601.1(b).

UNSAFE BUILDING. See Section 310.

VALUE OR VALUATION. The total value of all work, including the cost of materials and labor, used as a basis for determining the permit fee.

Exception: Costs associated with landscaping plant materials and irrigation systems are not to be included in the determination of the value of valuation for permitting.

WALL.

Bearing Wall. Wall supporting a vertical load in addition to its own weight.

Cavity Wall. Wall built of masonry units or of plain concrete, or a combination of these materials, arranged to provide an airspace within the wall and in which the inner and outer wythes of the wall are tied together with metal ties.

Faced Wall. Wall in which the masonry facing and backing are of different materials and are bonded to exert a common reaction under load.

Fire Division Wall. Wall constructed in accordance with Section 708 for subdividing buildings to restrict the spread of fire.

Foundation Wall. Wall below the floor nearest grade, supporting a wall, pier, column or other structural part of a building or structure.

Masonry-Bonded Hollow Wall. Wall built of masonry units arranged to provide an airspace within the wall, in which the inner and outer wythes of the wall are tied together with masonry units.

Nonbearing Wall. Wall that supports no vertical load other than its own weight.

Panel Wall. Nonbearing wall built between columns and piers wholly supported at each story.

Veneered Wall. Wall having a facing of masonry, plastic, glass or other material securely attached to the backing, but not bonded to exert a common reaction under load.

WATERWAY. Channel of water navigable by boats. When located within a special amusement building, the occupant load assigned to waterways shall not exceed the maximum load capacity of the ride vehicles.

WRITING. Includes handwriting, typewriting, printing, photo-offset or any other form of reproduction in legible symbols or characters.

WRITTEN NOTICE. Notification, in writing, delivered in person to the individual or to the parties for whom intended, or delivered or sent by certified or registered mail to the last business address known to the agency giving notice.

YARD. Open, unoccupied space, other than a court, unobstructed from the ground to the sky, except where specifically provided by this Code, on the lot on which a building is located. (See “Court.”)

CHAPTER 3

BUILDING PERMITS, COMPLIANCE OF BUILDINGS AND STRUCTURES

SECTION 301 PERMITS

301.1 Permits required.

- (a) **When required.** Any owner, authorized agent, person or contractor who desires to construct, enlarge, alter, repair, move, demolish or change the occupancy of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any electrical, gas, mechanical or plumbing system, the installation of which is regulated by the technical codes, or to cause any such work to be done, shall first make application to the Building Official and obtain the required permit for the work.

Exceptions:

1. Replacement may be made without a permit provided that:
 - 1.1. Replacement shall not violate any of the provisions of this Code.
 - 1.2. The value of labor and materials, as determined by the Building Official, to replace the item does not exceed \$2,500. For the purpose of this Section, permits may not be evaded by performing a series of small replacements consecutively.
 - 1.3. The replacement is not required to meet wind-loading requirements or is not a structural member.
 - 1.4. The replacement is not part of a pressurized piping system, including natural and LP gas. For the purpose of this Section, sinks, lavatories, water closets, urinals and their associated faucets, ball cocks or flush-o-meters shall not be considered as part of a pressurized system.
 - 1.5. The replacement does not require modifications to ductwork in order to retrofit replacement air-handling equipment or fans.
 - 1.6. Replacement components are identical in terms of equipment ratings, listings, function and performance.
 - 1.7. The replacement is not a component of a fire-resistive assembly.
 - 1.8. Fences or railings less than 3 feet high.

2. Walking or driving surfaces that are not structural elements, not over any basement or story below, not more than 30 inches above adjacent grade and/or not part of an accessible route shall be exempt from permitting and inspection.

- (b) Separate permits shall be required for plumbing, air-conditioning, heating and ventilating systems, elevators, escalators and transporting assemblies, gas, sprinkler, roofing, electrical, fire alarm systems, security alarm systems, swimming pool, project management and show/ride installations.

- (c) A previously issued lawful permit shall be valid on the terms of the code under which it was issued, provided that no such permit shall be subject to the limitations specified in this Section.

- (d) **Temporary structures.** A special building permit for a limited time shall be obtained before the erection of temporary structures, such as construction sheds, seats, canopies, tents and fences, used in construction work or for temporary purposes, such as reviewing stands. Such structures shall be completely removed upon expiration of the time limit stated in the permit.

301.2 Other jurisdictions. Permits required for work to be accomplished under the jurisdiction of other District departments shall be issued only on presentation of written proof of compliance with Subsection 105.1.

SECTION 302 APPLICATIONS

302.1 Permit application requirements. A permit application shall be filed and the permit shall be issued prior to commencement of work. Application documentation may be required such as, but not limited to, the following:

- (a) A completed permit application, notarized when applicable.
- (b) Payment of permit and plan review fees.
- (c) A site plan meeting the requirements of Subsection 302.5.
- (d) A copy of the contract or purchase order that provides verification of the job valuation as defined in Chapter 2.
- (e) Two sets of drawings, specifications and calculations, including a demolition plan, where applicable.
- (f) Professionally designed, signed and sealed plans and specifications when the valuation of the work is more than \$25,000, or for work of a structural nature, or work requiring wind loading, regardless of the valuation.
- (g) An owner's signature for work more than \$2,500.

- (h) A Notice of Commencement for work more than \$2,500.
- (i) Additional plans requiring the approval of a state or local government agency, such as the Florida Department of Business and Professional Regulation, Hotel Restaurant Division or the Health Department.
- (j) Fire Alarm submissions over \$5,000 must be signed and sealed by a design professional.

302.2 Surveyor's certificate required. Application for permit for new construction and additions shall be accompanied by a registered land surveyor's certificate and plan, in duplicate, on which shall be indicated clearly the property corner stakes, property line dimensions, existing structures and their location, existing rights-of-way, sidewalks, easements, street zoning and property zoning of record, critical elevations and building setbacks required by law, general block plan and other pertinent survey data that may be required. The Building Official may waive the requirements for such survey when property line stakes are known to be in place, and when the work contemplated is minor and is clearly within building lines.

302.3 For relocation of buildings. Application for permit for relocating a building within the District shall be submitted in the form that the Building Official requests. The application shall be accompanied by plans or other data that, in the opinion of the Building Official, are necessary to show compliance with this Code and the zoning, and other regulations of the District. A physical examination of the structure shall be made by the Building Official before he issues a permit for relocation. [See Subsection 306.1(b).]

302.4 For demolition of buildings and structures. Application for permits for the work of demolition of buildings or structures shall be accepted only from qualified persons or firms to do the work. Qualifications of persons or firms to demolish the building or structure shall be in accordance with a special ordinance of the District providing for qualification and certification of construction tradesmen.

302.5 Site plan requirement.

- (a) Prior to the commencement of any construction on a development parcel within the District, the applicant shall provide the District Manager of Planning and Development with a site plan for the entire development parcel at a suitable scale, depending on the size of the development parcel. A development parcel is defined as the land containing a proposed project, exclusive of lands designated as conservation on the Future Land Use Map of the District's Comprehensive Plan and/or public road rights-of-way contained within the proposed project. The development parcels are shown on a map available from the Planning and Development Department.
- (b) The minimum criteria for inclusion in a site plan application are as follows:
 1. Name of project.
 2. Statement of the intended use of the site.
 3. Legal description of the development parcel.
 4. Size, in acres, of the proposed development.

- 5. Evidence that the soil conditions are suitable for the proposed development.
- 6. The amount of impervious surface within the development parcel.
- (c) The minimum contents of a site plan are as follows:
 1. The footprints of all structures, including the square footage and/or number of rooms, as may be appropriate.
 2. The total acreage within the development parcel.
 3. The location and size of all storm water management facilities within the development parcel.
 4. The location and number of all required parking spaces to serve the development, with the required number of accessible spaces being specifically designated.
 5. The location and size of the open space within each development. A minimum of 30 percent of the area of each development parcel shall be maintained in open space.
 6. The location and size of proposed and/or existing road rights-of-way; proposed and/or existing transit corridors or facilities as may be appropriate; and location of pedestrian facilities, both existing and proposed.
 7. The limits of the 100-year flood plain as determined by consultation with the District engineer.
 8. The most landward limits of either the South Florida Water Management District (SFWMD), the Federal Department of Environmental Regulation (FDER) or the Army Corps of Engineers (ACOE) wetland jurisdictions.
 9. The location of proposed and/or existing types of landscaped and hardscape areas.

302.6 Alteration of buildings and structures.

- (a) **Compliance with Code.** Buildings or structures to which additions, alternations, repairs or changes of occupancy are proposed or intended shall be made to comply with all requirements for new buildings or structures of like area, height, type of construction or occupancy classification, except as provided in this Section.
- (b) **Alterations of 25 percent or less.** Alterations and repairs to any part of a building within any 12-month period, the cost of which does not exceed 25 percent of the value of the building or structure, shall comply with the requirements of this Code for new buildings or structures, except that minor structural additions, alterations and repairs may be made with the same materials of which the building or structure is constructed. Such building or structure, including new additions, shall not exceed the area and height provided in this Code for the type of construction and occupancy classification.
- (c) **Alterations from 25 percent to 50 percent.** Alterations and repairs exceeding 25 percent, but not exceeding 50 percent of the value of a building or structure, may be made within any 12-month period without making the

entire building or structure comply with this Code. Additions shall conform to the requirements of this Code for a new building of like area, height and occupancy. The entire building or structure, including the new addition, shall not exceed the area and height specified in this Code for its type of construction and occupancy classification.

- (d) **Alterations of more than 50 percent.** When additions, alterations or repairs within any 12-month period exceed 50 percent of the value of a building or structure, such building or structure shall be made to conform to all requirements for a new building or structure, or shall be demolished.
- (e) **Roofing.** Not more than 25 percent of the roof covering of any building or structure shall be replaced in any 12-month period unless the roof covering of the entire building or structure is made to conform to the requirements of this Code.
- (f) **Value determination.** For the purpose of this Section, the value of an existing building or structure shall be determined by the Building Official.
- (g) **Structural determination.** For the purpose of this Section, structural shall mean any part, material or assembly of a building or structure that affect the safety of the building or that supports any dead or designed live load, or where the removal of any part, material or assembly could cause or be expected to cause any part of the building or structure to become unsafe or to collapse.
- (h) **Change of occupancy or nature of use.** An existing building for which the occupancy classification or the nature of use is changed shall comply with the requirements for a new building of the same occupancy classification and type of construction, except as follows:
 1. Where, in the opinion of the Building Official, the proposed occupancy or change in use is not more hazardous than the existing use, based on life and fire risk, the Building Official may approve such change of occupancy and may require compliance with the requirements of this Code for buildings of like occupancy or use that, in his opinion, are specifically pertinent to safeguard the life, health and welfare of persons.
 2. Change of occupancy classification or nature of use shall not be construed to be a change of tenants or ownership where the occupancy classification and nature of use remain the same. When a building or part thereof has been vacant for a period of six months or more, a new Certificate of Occupancy shall be obtained before tenancy begins.
- (i) **Time limitation of application.** An application for a permit for any proposed work shall be deemed to have been abandoned 180 days after the date of filing, unless such application has been pursued in good faith or a permit has been issued; except that the Building Official is authorized to grant one or more extensions of time for additional periods not exceeding 90 days each. The

extension shall be requested in writing and justifiable cause demonstrated.

SECTION 303 PLANS AND SPECIFICATIONS

303.1 Plans and specifications required.

- (a) Each application for a permit shall be accompanied by an electronic set of plans or two sets of hardcopy plans, specifications and calculations when required by the Building Official.
- (b) The Building Official may issue a permit without plans, specifications and calculations for small or finish work, but in every case where work is of a structural nature, plans, details and calculations shall be submitted for review and approval.
- (c) Unless specifically exempted by the Building Official, buildings and/or structures, alterations, repairs or improvements, replacements and additions with a valuation of \$25,000 or more except as noted in paragraphs 1 and 2 below; or where the finished work is designed for public occupancy, the plans and specifications shall be prepared and approved by, and shall bear the seal, signature and date of, a professional engineer or registered architect either of whom shall be registered in the State of Florida.
 1. Any specialized mechanical, electrical, or plumbing document which includes a medical gas, oxygen, steam, vacuum, toxic air filtration, halon, or fire detection and alarm system which costs more than \$5,000.
 2. Fire sprinkler documents which includes a fire sprinkler system which contains 50 or more sprinkler heads. Personnel as authorized by Chapter 633 Florida Statutes, may design a fire sprinkler system of 49 or fewer heads and may design the alteration of an existing fire sprinkler system if the alteration consists of the relocation, addition or deletion of not more than 49 heads, notwithstanding the size of the existing fire sprinkler system.
- (d) Plans for additions and alterations in which mechanical or electrical design is required shall, at the discretion of the Building Official, be prepared by and bear the seal of a professional mechanical or electrical engineer registered in the State of Florida.
- (e) Plans shall be drawn to scale, identified by name of designer and owner on every sheet, and shall be an electronic Portable Document Format (PDF) or mechanically reproduced prints. A plot plan shall show all occupied and unoccupied parts of the lot or lots. The use, name and occupancy of all parts of the building shall be shown, including all foundations, wall sections, floor plans, elevations and structural details. Mechanical, plumbing, electrical, fire sprinkler and alarm details shall be shown on the plans and representing the designs for those disciplines, along with such other information

as may be required to show clearly the nature, character and location of the proposed work.

- (f) Plans for all buildings shall indicate how required structural and fire-resistance integrity will be maintained where a penetration of a required fire-resistant wall, floor or partition will be made for electrical, gas, mechanical, plumbing and communication conduits, pipes and systems, and also indicate, in sufficient detail, how the fire integrity will be maintained where required fire-resistant floors intersect the exterior walls.
- (g) **Manufacturing and installation of amusement rides and devices.** Two sets of signed and sealed plans are required for the manufacturing and installation of all amusement rides and devices. All structural components of the ride or device structure, including vertical or horizontal structural support members, shall have structural calculations performed and submitted for approval. All amusement building systems including, but not limited to, structural, electrical, mechanical, plumbing or gas shall be signed and sealed by a licensed engineer.

Exception: In lieu of signed and sealed plans and specifications, a letter signed and sealed by a professional engineer, registered in the State of Florida, attesting that the design of the amusement ride or device complies with ASTM F24 and EPCOT Standard 5-13 may be accepted at the discretion of the Building Official.

1. For the purpose of this Section, definitions of amusement ride and amusement device found in Subsection 5-13.101.3 shall apply.

303.2 Examination of plans.

- (a) The Building Official shall examine all plans and applications for permits and amendments thereto for their compliance with this Code. If the applications or the plans do not conform to the requirements of all pertinent laws, the Building Official shall reject such application for a building permit in writing, stating the reasons therefor. Plans that are rejected may be returned for corrections. If, upon examination, the application, plans and specifications are found to comply with the requirements of this Code, the plans shall be signed by the Building Official or his deputy and shall be stamped "APPROVED." [See Subsection 305.2(b).]
- (b) When practical difficulties are involved in carrying out the requirements of this Code, the Building Official may grant modifications for individual cases. This requires first a finding that a special individual reason makes strict conformance impractical and second that the modification is in compliance with the intent and purpose of this Code. Fire protection and structural integrity shall not be lessened.
- (c) Upon approval of the Building Official of a plan to segment the construction into more than one permit, drawings shall be submitted for each permit phase. All work in any permit phase shall be at the complete risk of the contractor and owner. Upon approval of the drawings,

specifications and calculations of that phase, a permit will be issued for that phase.

303.3 Partial approval.

- (a) Pending the completion of checking of plans and specifications, and on payment of the fee required, the Building Official, at his discretion, may authorize the issuance of a temporary permit for site preparation, excavation, construction, foundation, structural and/or show/ride installations. The holder of such temporary permit shall proceed at his own risk and without assurance that a completion permit will be granted.
- (b) Whenever there is a delay in approval of plans under similar special circumstances, the Building Official may permit the builder to place tool sheds, materials, batterboards and construction equipment on the site prior to actual construction, or may permit exploratory uncovering of concealed structural elements of existing buildings for design information, pending completion of plans for proposed alterations.
- (c) Upon approval by the Building Official of a plan to segment the construction into more than one permit, drawings and permits shall be submitted for each phase. All work in any phase is at the complete risk of the contractor and owner. Upon approval of the drawings, specifications and calculations of that phase, a permit shall be issued for that phase.
- (d) The drawings for each phase must be complete in themselves so that review and inspection can properly be made. Preliminary plans of the total building shall be submitted in enough detail with the working drawings so that proper evaluation can be made. Areas and items not included in the phase to be permitted shall be shown as not included.

303.4 Approved plans.

- (a) The Building Official shall retain one set of the approved plans, specifications and computations. The other set shall be kept at the building site, open to inspection at all times when the offices of the District are open.
- (b) After permit issuance, all changes and deviations from the approved plans shall be submitted to the Building Official for approval.
- (c) Approved plans and amendments thereto, which are retained by the Building Official, shall become public record; provided, however, that they be considered as confidential records of their author, that they shall be open to the public only for inspection, that the Building Official may permit bona fide owners or designers employed by such owners to inspect the plans when not available from their author. Upon written application, the Building Official may permit the plans to be copied by the owner in the event of the author's death or inability of the author to supply copies of the plans.
- (d) At the time a Certificate of Occupancy is issued, an updated set of plans and specifications shall be submitted and a permit fee shall be paid to reflect increased costs.

303.5 Multi-tenant buildings. Buildings, which may be completed in phases due to occupancy by tenants, shall be permitted for completion by owner to a rough-in status. The individual tenant area shall then have a permit issued and, upon completion of all work, a Certificate of Occupancy will be issued for that area only. The Building Official must approve the Certificate of Occupancy by stages before starting construction, and may require special conditions to provide safety during the completion.

Buildings, which will later be occupied by multiple tenants (lessees), may be permitted to have certain areas constructed to an unfinished “rough-in” condition without affecting the Certificate of Occupancy issued for the finished portions of the buildings. Future construction to accommodate individual tenants may be approved upon submittals of acceptable plans and specifications for permit purposes. Certificates of Occupancy will be granted on a case-by-case basis when code compliance has been achieved.

Construction in individual tenant areas may require special safety and fire protection measures to assure the safety of the building occupants during construction operations.

SECTION 304 PERMIT FEES

304.1 Fee required. Any person requiring a building permit, in addition to filing an application therefor and before such permit is issued, shall pay such permit fee and plan check fee as required by the District.

304.2 Basis of permit fee. The Building Official may require an estimate of cost and other descriptive data as a basis for determining the permit fee. The permit fee and plan review fee shall be based on the valuation of the work to be done. The valuation shall include the total value of all work, including the cost of materials and labor, and shall be based on the contract or selling price of the installation or alteration, and shall include electrical, plumbing, mechanical, sprinkler, elevator and owner-furnished equipment.

Exception: Costs associated with landscaping plant materials and irrigation systems are not to be included in the determination of the value or valuation of permitting.

304.3 Refunds. Permit and plan review fees are nonrefundable.

SECTION 305 CONDITIONS OF PERMIT

305.1 Permit card. When plans, specifications and application for permit have been approved and the required fee has been paid, the Building Official will issue a permit for the work. With each permit, the Building Official shall issue a weather-resistant permit card bearing the legal description of the property, the nature of the work being done, the names of the owner and builder or contractor, and other pertinent information. The permit card shall be posted and maintained in legible condition in a conspicuous place within 200 feet of

the construction area during the entire time period the work authorized by the permit is in progress.

305.2 Compliance with Code.

- (a) Issuing or granting of a permit or approval of plans and specifications by the Building Official shall not be construed to be a permit for, or an approval of, any violations of any of the provisions of this Code. No permit presuming to give authority to violate or cancel any of the provisions of this Code shall be valid, except insofar as the use of work which it authorizes is lawful.
- (b) When plans and specifications have been approved, the issuance of a permit shall not prevent the Building Official from thereafter requiring correction of errors in such plans and specifications, or from preventing building operations being carried on thereunder in violation of this Code or of any other regulations of the District applicable thereto. Compliance with this Code is the responsibility of the owner or his authorized agent.

305.3 Time limitation.

- (a) Permits shall expire if the work authorized by such permit is not commenced within six months from the date of the permit, or if, after commencing, the work is suspended or abandoned for a period of six months at any time during construction operations. The Building Official may extend such permit for a period of 90 days from the date of expiration if the work has not commenced, or for a period of 90 days from the date of the last recorded inspection, if written application for such extension is received and approved by the Building Official prior to the date of expiration of the initial permit, and provided that the proposed work complies with all requirements of the code in effect at the time of such renewal.
- (b) A previously issued lawful permit shall be valid on the terms of this Code under which it was issued, provided, however, that such permit shall be subject to the limitations specified in this Section.
- (c) Before work for which a building permit has become void can be resumed, a new permit shall be required. The work for which the new permit is issued shall conform to the provisions of this Code at the time of reissuance of the permit. The fee shall be based on the amount of work remaining to be done.

305.4 Revocation of permit.

- (a) The Building Official may revoke a permit or approval issued under the provisions of this Code when any false statement or misrepresentation of fact is made in the application or on the plans on which the permit or approval was based.
- (b) Whenever the work for which a permit has been issued is not being performed in compliance with plans, specifications or descriptions, or approved plans are not being kept at the site, the Building Official shall notify the contractor or owner, or their agent, in writing that the permit is suspended. Written notice shall be mailed or given to the permit holder or his agent, and it shall be

unlawful for any person or persons to perform any work in or about the building or structure, except work required for correction of the violations. If, in the judgment of the Building Official, there is imminent danger that requires immediate action, the permit may be revoked or suspended verbally and written notice may be served later.

- (c) When a permit has been suspended it shall not be reinstated until all violations have been corrected. Written notice of reinstatement shall be given to the permit holder when requested.

SECTION 306 INSPECTION

306.1 Inspection required.

- (a) Before issuing a permit, the Building Official may inspect any building or structure for which an application has been received for a permit to enlarge, alter, repair, relocate, demolish or change the occupancy thereof. The Building Official shall inspect all buildings and structures from time to time during the work for which a permit was issued and on completion of the work. The Building Official shall cause to be kept a record of every inspection and of all violations of this Code, and of the correction and disposition of such violations.
- (b) Before a building permit is issued for moving a building or structure within or into the District, such building or structure shall be inspected by the Building Official. The Building Official shall ascertain that the building being relocated complies with the requirements of this Code and all other applicable laws or regulations of the District.
- (c) All construction or work for which a permit is required shall be subject to mandatory inspections by the Building Official as prescribed in Subsection 306.2, and certain types of construction shall have special engineering inspections as specified in Subsection 306.3. Prior to issuance of a Certificate of Occupancy, a final inspection shall be made by the Building Official of all construction or work for which a permit has been issued.
- (d) When considered necessary by the Building Official, he shall make an inspection of materials or assemblies at the place of manufacture or fabrication. He shall keep a record of every such inspection and of all violations of this Code noted during the inspection.
- (e) The Building Official may make or cause to be made the inspections required in this Section. He may accept written reports of inspectors employed by approved inspection services, provided that after investigation the Building Official is satisfied as to the qualifications and reliability of the inspection service. No certificate called for by any of these requirements shall be based on such reports, unless the reports are in writing and are certified by the officer of the agency who made the inspection. Reports issued by inspection services engaged by owner, designer or contractor of a building shall be

promptly forwarded to the Building Official for his information and records.

- (f) Work requiring a building permit shall not be commenced until the permit holder or his agent shall have posted the building permit card in accordance with the requirements of Subsection 305.1. This permit card shall be maintained in such position by the permit holder until the Certificate of Occupancy has been issued by the Building Official.

306.2 Mandatory inspections.

- (a) Work requiring mandatory inspections shall not be covered or concealed in any manner without first obtaining the approval of the Building Official.
- (b) Work shall not be done on any part of a building or structure beyond the stage of work indicated in each of the successive mandatory inspections until inspection has been completed and written approval has been given by the Building Official or his deputy.
- (c) The permit holder or his agent shall notify the Building Official of the time when that stage of construction will be ready for inspection. The Building Official shall then make such called inspection and other inspection as may be necessary, and he shall either approve, in writing, on the permit card that part of the construction as completed or shall notify the permit holder or his agent specifically wherein the work fails to comply with the provisions of this Code.
 1. **Foundations.** When the excavation for footings is complete, footing forms, required anchorage and reinforcing steel are in place, but before concrete is placed.
 2. **Reinforcing steel (lower stresses).** After all reinforcing steel is in place, slab, soffit, beam, girder, column and joist forms, on one side of wall forms are in place and are braced, before the concrete is placed and reshoring after concrete placement.
 3. **Framing.** To be made at each floor level and after all floor, wall and roof framing, and fire blocking are complete; welds and clip connections are made and all pipes, chimneys, vents, ductwork, rough plumbing and rough electrical work are in.
 4. **Insulation.** To be made before lathing, wallboard or other finishes are applied.
 5. **Lathing and wallboard.** When supports, backing, lath, and (or) wallboard are in place and ready for plaster and other finish work, and all plastering materials are delivered on the job, but before any finish is applied and before wallboard joints and fasteners are taped and finished.
 6. **Roofing.** After anchor sheet or sheets are on, secured and before installation of capsheet or other finish course.
 7. **Masonry.** After units are set, reinforcing steel is placed and prior to grouting.

8. **Structural steel.** When structural steel members and required connections are complete, but before concealing any members or connections.
 9. **Plumbing and gas systems.** To be made in accordance with the requirements of the *EPCOT Plumbing Code* and the *EPCOT Fuel Gas Code*.
 10. **Electrical systems.** To be made in accordance with the requirements of the *EPCOT Electrical Code*.
 11. **Heating and ventilating systems.** To be made in accordance with the requirements of the *EPCOT Mechanical Code*.
 12. **Fire protection systems.** Shall be in accordance with applicable standards.
 13. **Special inspections.** To be made immediately after completion and at such intervals during the progress of the work as the Building Official may require, and as follows:
 - **Elevators, escalators, transporting assemblies and amusement rides.** To be made in accordance with the requirements of EPCOT Standard 5-1.
 - **Swimming pools.** To be made in accordance with the requirements of Appendix E.
 - **Signs.** To be made in accordance with the requirements of Appendix D.
 14. **Other inspections.** To be made as the Building Official, owner or contractor may reasonably request. Prefabricated assemblies may be inspected at the place of manufacture as set forth in Subsection 306.1(c).
 15. **Final inspection.** To be made when the building or structure is completed and is ready for use or occupancy.
- (d) Requests for final inspections shall be made to the office of the Building Official, and reasonable time shall be allowed for such inspection to be made. Rejection or refusal to approve the work for reasons of incompleteness, violation of the provisions of this Code or inadequacy of the construction shall nullify the request for final inspection. The work shall be made to comply with this Code and the request for inspection shall be repeated as required herein.

306.3 Special engineering inspection.

- (a) In addition to the mandatory inspections to be made by the Building Official as specified in Subsection 306.2, continuous inspection by an approved independent engineering inspector shall be required under the following conditions:
1. Reinforced concrete with design strength of more than 2,500 pounds per square inch.
 2. Reinforced masonry work when using full design stresses.
 3. Multiple-pass welding of all structural metals in both shop and field.

4. High-strength bolts—shop and field.
 5. Foundation piles—all types.
 6. High-lift grouting of structural reinforced masonry.
 7. Pneumatically applied structural mortar or concrete.
 8. Prestressed concrete.
 9. Other items, at the discretion of the Building Official. The Building Official may waive continuous inspections when minor quantities of structural materials are used and where no unusual hazards are present; or, where in the judgment of the Building Official, the unit stresses used in design do not exceed those permitted elsewhere in this Code for work not continuously inspected and where no unusual hazards are present.
- (b) **Special periodic inspections.** In addition to the continuous inspections to be made as required in Subsection 306.2, there may be required special periodic inspections by an approved independent engineering inspector at intervals to be determined by the Building Official and under the following conditions:
1. Structural lightweight concrete at batching and placing locations.
 2. Reinforced gypsum concrete.
 3. Open-web joist—complete examination at site, prior to erection.
 4. Single-pass structural welds designed for more than 50 percent of permitted stresses for structural materials.
 5. Precast concrete.

306.4 Entertainment functions and special event inspections. Any function involving the use of temporary tents, stages, performance platforms, bleachers, show power or trailers shall comply with the provisions established for temporary structures in Subsections 301.1(d), 302 and 308.5. A Certificate of Occupancy shall be issued upon completion of all mandatory inspections.

306.5 Inspection reports. The Building Official shall keep a record of all inspections made, results, plans filed, surveys made and Certificates of Occupancy issued.

SECTION 307 CLEANUP OF SITE

307.1 Cleanup of site. Upon completion of the proposed work, the permit holder shall clear the site of rubbish, debris, construction sheds or materials of construction. In the event that there has been damage to public property, or that rubbish, debris, construction sheds or materials of construction have been left at the site, the Building Official shall refuse to make final inspection and shall notify the permit holder to correct the condition of violation within five days. For failure to comply with such notice after such period of five days, the permit holder shall be subject to the penalties specified herein. The Building Official shall have the cleanup work done and the

public property restored in accordance with the applicable requirements of Chapter 4 and Appendix F, in which event the costs therefore shall become a lien against the property on which the permit was issued.

SECTION 308 CERTIFICATE OF OCCUPANCY

308.1 Certificate required.

- (a) No building hereafter erected, altered, enlarged or relocated, or where a change of occupancy has been made, shall be used in whole or in part until a Certificate of Occupancy has been issued by the Building Official certifying that the building and occupancy are in accordance with the provisions of this Code and all other laws and regulations applying thereto. When the building or part thereof complies with the provisions of all pertinent laws and regulations, the Building Official shall issue the Certificate of Occupancy for the building or part thereof. A Certificate of Occupancy for places of assembly shall indicate thereon and make record of the number of persons for which such certificate is issued. In all manufacturing, commercial, storage or warehouse occupancies, the design live loads shall be plainly posted.
- (b) Any building altered and/or enlarged, when in the opinion of the Building Official, is in compliance with this Code, the owner shall be issued a letter affirming compliance in lieu of a Certificate of Occupancy.

308.2 Existing occupancy. If an occupancy that was authorized prior to the adoption of this Code does not comply with the requirements of this Code, the Building Official shall issue a new Certificate of Occupancy therefore, unless the building and use, in his opinion, constitute a serious hazard to life, limb or property. If an application for a new Certificate of Occupancy is denied, such existing occupancy shall be in violation of this Code.

308.3 Revocation of certificate. The Building Official shall revoke a Certificate of Occupancy for any building occupied in whole or in part for any use not authorized in this Code, or in other laws and regulations of the District, or that is changed in occupancy to a classification not complying with this Code, or for any building where the live load imposed on any floor, or where the number of persons permitted to assemble therein or thereon exceed those authorized in said Certificate of Occupancy. Continued use of the building or structure after the revocation of said certificate shall be in violation of this Code.

308.4 Temporary Certificate Of Occupancy. A Temporary Certificate of Occupancy may be issued by the Building Official for the use of parts of a building prior to completion of the entire building.

308.5 Connection of services. It shall be unlawful for a public service corporation or agency to begin utility service to a building or structure, except temporary service for use during building construction and/or testing operations, until a Certificate of Occupancy has been issued.

SECTION 309 MAINTENANCE OF BUILDINGS AND PROPERTY

309.1 Buildings. The requirements contained in this Code for maintenance of buildings shall apply to all buildings and structures in existence on the date of enactment of this Code and those hereafter erected. All buildings and structures, and all parts thereof, shall be maintained in a safe condition, and all devices and safeguards required by this Code shall be maintained in operating condition. This Section shall not be construed as permitting the removal or nonmaintenance of existing devices or safeguards, unless authorized by the Building Official.

309.2 Property. No debris shall remain on any property, sidewalk or street contiguous thereto, resulting from fire, windstorm, demolition or partial demolition of any building; nor shall any equipment, excess building materials, storage shed or debris remain upon any such property, sidewalk or street upon completion of any new building upon such lot; nor shall any equipment, materials, toolshed or debris be stored on any vacant or partly vacant lot, except as provided in the land use regulations of the District.

309.3 Existing installations. Buildings in existence at the time of the adoption of this Code may have their existing use or occupancy continued if such use or occupancy was legal at the time of the adoption of this Code, provided such continued use is not dangerous to life.

SECTION 310 UNSAFE BUILDINGS

310.1 Unsafe building defined. All buildings shall be considered unsafe buildings that are, or that hereafter become unsafe, unsanitary or deficient in exit facilities; or that constitute a hazard from fire or windstorm; or that are otherwise dangerous to human life or public welfare by reason of illegal or improper use, occupancy or maintenance; or that do not comply with the provisions of applicable codes; or that have been substantially damaged by the elements, acts of God, fire or explosion, or other cause; or that are incomplete buildings for which building permits have expired. All such buildings, deemed to be unsafe by the Building Official, are hereby declared to be public nuisances and shall be demolished and removed from the premises concerned or shall be made safe and sanitary in a manner required by the Building Official and as provided in this Section and other applicable laws and regulations of the District.

310.2 Criteria.

- (a) A building shall be deemed to be a fire hazard and unsafe when it is vacant and unguarded and open at door or window; or when there is an unwarranted accumulation of dust, debris or other combustible materials therein; or when the building does not provide the exits or fire protection required herein for the most recent occupancy; or when the electrical or mechanical installations or systems create a hazardous condition. The falling away, the hanging loose or loosening of any siding, block, brick or other building material, structural

member, appurtenance or part thereof of a building; the deterioration of the structure or structural parts of a building; a partially destroyed building; any unusual sagging or leaning out of plumb of a building or any part of a building, when caused by deterioration or over-stressing, all shall be considered unsafe. The existence of unsanitary conditions by reason of inadequate malfunctioning sanitary facilities or waste disposal systems shall be considered unsafe. Buildings which, by reason of illegal or improper use, occupancy or maintenance, do not conform to provisions of this Code shall be considered unsafe.

- (b) If the cost of alteration, repair or replacement of an unsafe building or part thereof exceeds 50 percent of its value, the building shall be demolished and removed from the premises. If the cost of alteration, repair or replacement of an unsafe building or part thereof does not exceed 50 percent of such replacement cost, the building may be repaired and made safe as provided in Section 302.
- (c) If the cost of structural repair or structural replacement of an unsafe building or part thereof exceeds 33 percent of the structural value, such building or part thereof shall be demolished and removed from the premises; and if the cost of such structural repairs does not exceed 33 percent of such replacement cost, such building or part thereof may be structurally repaired and made safe, as provided in Section 302.
- (d) To determine the value of a building and the cost of alterations, repairs and replacement, the regulations in Subsection 302.6(f) shall apply.

310.3 Inspection of unsafe buildings. The Building Official, on his own initiative or as a result of reports filed with the Department of Building and Safety, shall examine or cause to be examined every building appearing to be or reported to be unsafe, and if such is found to be an unsafe building as defined in Section 310, the Building Official shall post the property on which the building is located and shall furnish the owner of such building with a written Notice of Violation. The manner of posting and furnishing written notice shall be as provided in Subsections 310.4 to 310.6 inclusive.

310.4 Notice of violation. At least 14 days prior to posting a noncomplying building, the Building Official shall give the owner of the premises written notice by certified mail, addressed to the owner's last known address. If proof of service by certified mail is not completed by signed return receipt, a copy of the written notice shall be affixed to the structure concerned and such procedure shall be considered proper service, and the time for compliance stipulated in the notice shall commence with the date such notice is so affixed. This written notice shall state the defects that constitute a violation of this Code and prescribe the action to be taken by the owner of the building to comply with this Code and the time within which compliance must be accomplished. Such time shall be reasonable under the circumstances of the case, subject to reasonable extension when requested in writing, for reasons which the Building Official considers as justifying an extension of time. All extensions of time shall be by written

approval of the Building Official. In addition, this written notice shall explain the right of appeal of the decision of the Building Official to the Board of Appeals, and shall state that unless there is compliance with the instructions in the Notice of Violation, or an appeal is filed, that a public hearing before the Board of Appeals will be initiated by the Building Official after the time period for compliance has expired.

310.5 Recording notice of violation.

- (a) If the owner of the property has not complied with the requirements as stated in the Notice of Violation within the time specified, the Building Official may file an appropriate instrument in the office of the Clerk of the Circuit Court, to be recorded in the public records of the County in which the violation occurred, indicating that violations of this Code, and of Section 310 thereof exist upon the property involved.
- (b) The recording of such notice shall constitute legal notice to all concerned, as well as any subsequent purchasers, transferees, grantees, mortgagees, lessees, and all persons claiming or acquiring interest in the property.
- (c) When a violation specified in the Notice of Violation has been corrected and the filing fees incurred have been paid, the Building Official shall file a certificate attesting that the violation has been corrected.

310.6 Posting notice of violation. The Building Official shall post a signed notice in a conspicuous location on the building that has been determined to be unsafe, but not before 14 days after the Notice of Violation provided in Subsection 310.4 has been served. The posted notice shall be dated and shall read: "UNSAFE BUILDING – This building is unsafe, in the opinion of the Building Official, as specified in Section 310 of the *EPCOT Building Code*. This building shall be vacated, shall not be occupied. Action shall be taken by the owner as further prescribed by written notice previously served. THIS NOTICE SHALL NOT BE REMOVED EXCEPT BY THE BUILDING OFFICIAL."

310.7 Emergency action.

- (a) When, in the opinion of the Building Official, there is actual or immediate danger of the failure or collapse of a building, or when there is a health, windstorm or fire hazard, the Building Official may order the occupants to vacate, temporarily close for use or occupancy the rights-of-way thereto, sidewalks, streets or adjacent buildings, or nearby areas, and institute such other temporary safeguards, including securing and posting of the building as the Building Official may deem necessary under the circumstances. The Building Official may employ the necessary labor and materials to perform the required work as expeditiously as possible.
- (b) Costs incurred in the performance of such emergency work shall be paid by the governmental authority having jurisdiction. Upon recording in the public records of the County in which such emergency work was completed, a certificate, executed by the Building Official, certifying the amount expended and the reasons therefore, the cost shall become a lien against the property on which such emergency work was required.

310.8 Appeal and review. The owner of, or anyone having an interest in, a building that has been determined to be unsafe, concerning which a Notice of Violation has been served by the Building Official as stated in the Notice of Violation, may appeal to the Board of Appeals and such appeal shall be filed in accordance with the provisions of Subsections 106.6 and 106.7 prior to the expiration of the time allowed for compliance specified in such notice. In no case shall the appeal period be less than 15 days.

SECTION 311 ALTERNATIVE MATERIALS AND METHODS OF CONSTRUCTION

311.1 Alternatives permitted. The provisions of this Code are not intended to prevent the use of construction systems, materials, methods of design or interpolations, calculations, evaluations or similar evidence based upon test data acceptable to the Building Official as alternatives to the standards and provisions set forth in this Code. Such alternatives may be offered for approval and their consideration shall be as provided in this Section.

311.2 Standards. Construction systems, materials or methods of design referred to in this Code shall be considered as standards of quality and strength. New or alternative construction systems, materials or methods of design shall be at least equal to and meet the intent of these standards for the corresponding use intended. Test or prototype installations of new materials, methods or systems may be permitted for scientific and development purposes.

311.3 Application.

- (a) Any person desiring to use construction systems, materials or methods of design not specifically mentioned in this Code shall file with the Building Official a request for permission to use such systems, materials or methods, together with proof in writing from an approved agency, in support of claims that may be made regarding the sufficiency of such construction systems, materials or methods of design. If a test installation is proposed, a description of the location and purpose of test also shall be submitted.
- (b) Where a building or part thereof is a structural unit, the integral parts of which have been built or assembled prior to incorporation into the building, such building or part thereof shall conform to the requirements of this Code. Materials and assemblies shall be tested and certified in accordance with the provisions of this Section. Inspections shall be made by the Building Official as required in this Code for the materials and types of construction used in the prefabricated assemblies.

Exception: Continuous inspection may be required during prefabrication if the approved agency certifies to the compliance of the construction with this Code and supplies evidence of such compliance in writing by a professional engineer, a registered architect, or an approved agency or laboratory.

- (c) The Building Official shall approve such alternative construction systems, materials or methods of design when it is clear that the standards of this Code are at

least equaled. If, in the opinion of the Building Official, the standards of this Code will not be equaled by the alternative requested, he shall refuse approval for permanent work. He shall, however, give consideration to test or prototype installations.

311.4 Tests.

- (a) Whenever there is insufficient evidence of compliance with the requirements of this Code or evidence that any material or method of construction does not conform to the requirements of this Code, or to substantiate claims for alternative construction systems, materials or methods of construction, the Building Official may require tests for proof of compliance to be made by an approved agency at the expense of the owner or his agent.
- (b) Test methods shall be as specified by this Code for the material in question. If there are not appropriate test methods specified in this Code, the Building Official shall determine the test procedure to be followed.

311.5 Appeal. Any person whose request for use of alternative systems and materials or methods of design has been refused by the Building Official may appeal to the Board of Appeals by written request to the Secretary of the Board, and such written request shall be transmitted to the Board immediately. The method of appeal shall be as provided in Subsection 106.6.

CHAPTER 4

REGULATIONS FOR USE OF STREETS AND FOR PROJECTIONS OVER PUBLIC AND PRIVATE PROPERTY

SECTION 401 PROTECTION OF PEDESTRIANS DURING CONSTRUCTION OR DEMOLITION

401.1 General.

- (a) No persons shall place or store any material or equipment necessary for the work under a building permit, on a street, alley or public sidewalk, nor shall any work be performed, except in accordance with the provisions of this Chapter and Appendix F.
- (b) No person shall perform any work on any building or structure, if by so doing he endangers pedestrians on the street that abuts the property line, unless the pedestrians are protected as specified in this Chapter.
- (c) Any material or structure temporarily occupying public property, including fences and walkways, shall be adequately lighted between sunset and sunrise.

401.2 Temporary use of streets or alleys. The use of public property shall meet the requirements of the District. Whenever requested, plot plans and construction details shall be submitted for review by the Building Official.

401.3 Maintenance and removal of protective devices. Required protective devices shall be maintained in place and kept in good order for the entire length of time pedestrians may be endangered. Every protection fence or canopy shall be removed within 30 days after such protection is no longer required for pedestrians.

401.4 Demolition. The work of demolishing any building shall be done in accordance with Appendix F and shall not be commenced until the required pedestrian protection structures are in place. The Building Official may require the permittee to submit plans and a complete schedule for demolition. Where such are required, no work shall be done until such plans and/or schedule are approved by the Building Official.

401.5 Construction fences. For requirements see Appendix F.

SECTION 402 PERMANENT OCCUPANCY OF PUBLIC PROPERTY

402.1 General requirements.

- (a) No part of any structure or any appendage thereto, except signs, shall project beyond the property lines of the building site, except as specified in this Section. Signs and their method of installation shall conform to the requirements of Appendix D.
- (b) Structures or appendages regulated by this Code shall be constructed of materials as specified in Section 707.

- (c) The projection of any structure or appendage shall be the distance measured horizontally from the property line to the outermost point of the projection.
- (d) No provisions of this Chapter shall be construed to permit the violation of other laws or ordinances regulating the use and occupancy of public property.

402.2 Projection into alleys.

- (a) No part of any structure or any appendage thereto shall project into any alley.
- (b) A curb or buffer block may project not more than 9 inches and not exceed a height of 9 inches above grade.
- (c) Footings located at least 8 feet below grade may project not more than 12 inches.

402.3 Space below sidewalk. The space adjoining a building below a sidewalk on public property may be used and occupied in connection with the building for any purpose not inconsistent with this Code, or other laws or rules regulating these, and occupancy of such spaces on condition that the right to use and occupy may be revoked by the District at any time and that the owner of the building will construct the necessary walls and footing to separate such space from the building and pay all costs and expenses attendant thereto.

402.4 Balconies and appendages. Oriel windows, balconies, unroofed porches, cornices, belt courses and appendages, such as water tables, sills, capitals, bases and architectural projections, may project over the public property of the building side a distance determined by the clearance of the lowest point of the projection above the grade immediately below, as follows:

Projections less than 8 feet are not permitted above a walking surface on public or private property. One inch of projection is permitted for every 1 inch above 8 feet, up to a maximum of 4 feet of projection.

402.5 Marquees.

- (a) For the purpose of this Section, a marquee shall include any object or decoration attached to or a part of said marquee. A marquee shall be fire protected as required in Chapter 7.
- (b) The horizontal clearance between a marquee and the curb line shall be not less than 2 feet.
- (c) A marquee projecting more than two-thirds of the distance from the property line to the curb line shall be not less than 12 feet above the ground of the pavement below.
- (d) A marquee projecting less than two-thirds of the distance from the property line to the curb line shall be not less than 8 feet above the ground or pavement below.

- (e) A marquee projecting more than two-thirds of the distance from the property line to the curb line shall not be more than 25 feet along the direction of the street.
- (f) The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed 9 feet.
- (g) A marquee shall be supported entirely by the building, constructed as specified in Section 707 and shall be of noncombustible material, or, when of Type VI construction, may be of 1-hour fire-resistive construction.
- (h) The roof or any part thereof may be a skylight when wired glass not less than $\frac{1}{4}$ inch thick is used and no single pane is more than 18 inches wide. Every roof and skylight of a marquee shall be sloped to downspouts, which shall conduct any drainage from the marquee under the sidewalk to the curb.
- (i) Every marquee shall be located so as not to interfere with the operation of any exterior standpipe or to obstruct the clear passage of stairways or exits from the building or the installation or maintenance of electroliners.

402.6 Movable awnings or hoods.

- (a) An awning is a movable shelter supported entirely from the exterior wall of a building and of a type which can be retracted, folded or collapsed against the face of a supporting building.
- (b) Such awning or hood may extend over public or private property not more than 7 feet from the face of a supporting building, nor within 2 feet of the curb line, measured horizontally.
- (c) Class I and II plastics may be used in awnings and canopies when constructed in accordance with the requirements for marquees in Subsection 402.5. (See Section 1008.)
- (d) Collapsible awnings shall be so designed that they shall not block a required exit when the awning is collapsed.
- (e) Movable awnings or hoods may have collapsible coverings supported on noncombustible frames attached to the building and entirely supported by the building.
- (f) Such awning or hood may extend over the public property not more than two-thirds the distance from the property line to the nearest curb in front of the building site.
- (g) All parts of awnings shall be at least 8 feet above a public walkway, except as permitted in Paragraph (h).
- (h) A valance attached to an awning shall be of cloth unless it is fabricated of the same material used for the roof of the awning. A metal valance shall not project above the roof of the awning at the point of attachment and shall not extend more than 12 inches below the roof of the awning at the point of attachment; nor shall any part of a valance be less than 7 feet above a public way.

402.7 Doors. Doors, either fully opened or when opening, shall not project beyond the property line.

402.8 Roof drainage. Drainage water collected from the roof of a building or structure, awning, canopy or marquee that exceeds 16 square feet in area, or condensate from mechanical equipment, shall not discharge on to a public walking surface.

CHAPTER 5

REQUIREMENTS BASED ON OCCUPANCY

SECTION 501 CLASSIFICATION OF OCCUPANCIES

501.1 Occupancies classified. Every building erected in the District shall be classified by the Building Official according to its present or intended use or occupancy as a building of Group A, AA, B, D, E, H, I, R or S occupancy, as set forth in Sections 504 to 516 and Table 5.1.

501.2 Unclassified occupancies. Any occupancy not clearly identified shall be classified by the Building Official in the group that it most nearly resembles, based on life and fire hazards of the proposed occupancy.

TABLE 5.1
CLASSIFICATION OF OCCUPANCIES

Group A – Assembly	
A-1	Assembly buildings with a stage; occupant load of 1,000 or more.
A-2	Assembly buildings with a stage; occupant load of 50 or more, but less than 1,000.
A-3	Motion picture theaters; occupant load of 50 or more.
A-4	Churches, places of worship or religious assembly; occupant load of 50 or more.
A-5	Assembly rooms; occupant load of 50 or more, including, but not limited to, multipurpose rooms, restaurants, night clubs, dance halls, bowling lanes, drinking or dining establishments, assembly areas contiguous to bus or train depots or airports, libraries and museums.
A-6	Stadiums and grandstands not classified in other divisions of Group A.
A-7	Temporary grandstands.
A-8	Studios, motion picture and television soundstages.
Group AA – Amusement ride structures	
AA	Amusement ride structures as defined in EPCOT Standard 5-13.
Group B – Business—Commercial	
B-1	Wholesale and retail stores, malls, mercantile and office buildings with an occupant load of 500 or more.
B-2	Wholesale and retail stores, mercantile and office buildings not classified in Group B-1; related storage areas, paint stores without bulk handling, restaurants or places supplying food or drink that accommodate less than 100 people.
B-3	Gasoline service stations, automobile parking garages where no repair work is done and where no flammable liquids are used.
B-4	Aircraft hangars where no repair work is done, except exchange of parts and maintenance requiring no open flame, welding or the use of highly flammable liquids, open parking garages and structures, heliports and helistops.
Group D – Detention and hospitalization.	
D-1	Mental hospitals, mental sanitariums, jails, prisons, reformatories and buildings where personal liberties are restrained.
D-2	Hospitals, sanitariums, nursing homes with nonambulatory patients and nurseries for the full-time care of children.
D-3	Nursing homes for ambulatory patients and homes for children over kindergarten age, each accommodating more than five persons.

(continued)

501.3 Change in occupancy. No change shall be made in the occupancy or use of a building unless such building complies with the requirements of this Code for such re-classification.

Exception: The occupancy of existing buildings may be changed with the approval of the Building Official, and the building may be occupied for purposes in other occupancy groups without conforming to all of the requirements of this Code for those groups when the new or proposed use is less hazardous than the existing use, based on life and fire risk.

TABLE 5.1—continued
CLASSIFICATION OF OCCUPANCIES

Group E – Educational	
E-1	Buildings or parts of buildings, or a group of buildings, on one property with an occupant load of 50 or more, used for education, instruction or recreation of pupils from kindergarten (including preschool) through the 12th grade, for 12 hours or more per week, or 4 hours or more in any one day, not included in Group A.
E-2	Buildings or parts of buildings, or a group of buildings, on one property with an occupant load of less than 50, used for education, instruction or recreation of pupils from kindergarten (including preschool) through the 12th grade, for less than 12 hours per week, or less than 4 hours in any one day, not included in Group B.
E-3	Buildings or parts of buildings used for day care or day nursery care of five children or more.
Group H – Hazardous	
H-1	Buildings or parts of buildings used for storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids.
H-2	Dry cleaning plants, paint stores and bulk handling, paint shops, paint spraying rooms and shops, and other uses requiring storage and handling of Class I, II or III flammable liquids.
H-3	Woodworking plants, planing mills and box factories, shops and factories where loose combustible fibers are manufactured or processed or where dust is generated, warehouses where highly combustible materials and high-piled stock are stored or kept.
H-4	Garages and aircraft hangars where maintenance and repair work is done.
Group I – Industrial	
I-1	Power plants, pumping stations, cold-storage buildings, creameries and ice plants.
I-2	Factories and warehouses wherein materials other than highly combustible are used, processed or stored; or where high-piled stock is warehoused, stored, used or processed.
I-3	Maintenance work shops and laboratories.
Group R – Residential	
R-1	Hotels, motels and similar facilities having three or more rooms for transient guests.
R-2	Multiple-residential apartment houses, convents, monasteries, dormitories, guest houses and facilities having three or more permanent residential units.
R-3	Dwellings of one and two units.

(continued)

TABLE 5.1—continued
CLASSIFICATION OF OCCUPANCIES

Group S – Satellite structures	
S-1	Private garages, carports, greenhouses, cabanas, bath houses, agricultural buildings, shade structures, guard shacks and kiosks.
S-2	Commercial stables.
S-3	Swimming pools.
S-4	Mobile homes, campers, trailers, unoccupied manufactured buildings and sheds.
S-5	Tanks and towers located above ground that support their own weight.
S-6	Fences as defined in Chapter 2.
S-7	Docks.
S-8	Animal support facilities.
S-9	Street lighting, signage, lift stations, electrical vaults or structures associated with roadway right-of-way.

SECTION 502

OCCUPANCY SEPARATION

502.1 Mixed occupancies.

- (a) When a building is used for more than one occupancy, each part of the building comprising a distinct occupancy, as described in this Chapter, shall be separated from other occupancies as specified in this Section and Table 5.2.
- (b) A building housing more than one occupancy shall conform to the requirements of this Code for height, area and type of construction applying to the principal occupancy of the building. Occupancies in the same building, other than the principal occupancy, shall not exceed the area limitations or be located at a story height greater than that permitted for such occupancy and the type of construction being used. [See Subsection 601.1(c).]
- (c) When minor accessory uses do not occupy more than 25 percent of the area of any floor of a building, nor more than the basic area permitted the occupancy by Table 7.5 for such minor use, for the purpose of determining permitted area, the principal use of the building shall determine the occupancy classification, when the uses are separated as specified in this Section.

Exception: The following accessory occupancies need not be separated from the primary occupancy as required herein:

1. An area used solely as a public dining room having an occupancy load of not more than 300 and accessory to a retail sales area classified in Group B-1, B-2 or R-1.
2. An assembly room not more than 750 square feet in area, when not accessory to a Group H (hazardous) occupancy.
3. Administrative, clerical or other office rooms, which, in the aggregate, are not more than 25 percent of the principal occupancy, when not accessory to a Group H occupancy, but shall be not more than the basic area permitted for the occupancy and type of construction.
4. Accessory rooms for educational instruction not more than 12 hours per week in buildings housing Group A-4 occupancies.

- (d) When a building is used for more than one occupancy, each part of the building housing a separate occupancy shall conform to all of the requirements of this Code for the occupancy housed therein.

502.2 Forms of occupancy separation. Occupancy separations shall be vertical, horizontal or both, or when necessary, of such other form as required to provide complete separation between occupancy divisions in the building.

502.3 Occupancy separations classified.

- (a) Occupancy separations shall be classified as, 3-hour fire resistive, 2-hour fire resistive and 1-hour fire resistive. (See EPCOT Standard 7-1 for specifications for fire dampers in air ducts piercing occupancy separations.)
- (b) A 3-hour fire-resistive occupancy separation shall be of not less than 3-hour fire-resistive construction. All openings in the walls forming such separation shall be protected by an approved opening protective having a 3-hour fire-resistive rating. The aggregate area of all openings in a 3-hour fire-resistive occupancy separation wall shall not exceed 25 percent of the wall in that story and no single opening shall have an area larger than 120 square feet. All openings in floors forming a 3-hour fire-resistive occupancy separation shall be protected by vertical enclosures extending above and below such openings. The walls of such vertical enclosures shall be not less than 2-hour fire-resistive construction and all openings therein shall be protected by an approved opening protective, as defined in Subsection 704.3, having a 1½-hour fire-resistive rating.
- (c) A 2-hour fire-resistive occupancy separation shall be of not less than 2-hour fire-resistive construction. The aggregate area of all openings in a 2-hour fire-resistive occupancy separation shall not exceed 25 percent of the wall area in that story. All openings in such separations shall be protected by an approved opening protective having a 1½-hour fire-resistive rating.
- (d) A 1-hour fire-resistive occupancy separation shall be of not less than 1-hour fire-resistive construction. The aggregate area of all openings in a 1-hour fire-resistive occupancy separation shall not exceed 25 percent of the wall area in that story. All openings in such separation shall be protected by an approved opening protective having a 1-hour fire-resistive rating.

502.4 Fire ratings for occupancy separations.

- (a) Separation shall be provided between the various groups and divisions of occupancies as specified in Table 5.2, and in accordance with Chapter 7 and other Chapters and parts of this Code.
- (b) Where the occupancy separation is horizontal, structural members supporting the separation shall be protected by an equivalent fire-resistive construction.
- (c) Storage areas of more than 30,000 cubic feet used for the storage of combustibles shall be separated from adjacent areas by not less than a 2-hour fire-resistive occupancy separation as specified in Subsection 502.3(c).

502.5 Tenant separations.

- (a) In a building or portion of a building of a single occupancy classification, when enclosed spaces are provided for separate tenants, such spaces shall be separated by not less than 1-hour fire resistance, except that in Group B buildings, non-fire-rated partitions may be used to separate tenants, provided no area between partitions rated at 1 hour or more exceeds 3,000 square feet.
- (b) Such wall shall be continuous from the foundation to the underside of the roof sheathing. The roof sheathing shall be of noncombustible material or fire-retardant-treated wood for not less than a 4-foot width on each side of such wall.

Exception: The exceptions for occupancy separations shall be applicable to tenant separations as permitted in Subsection 502.1(c).

502.6 Separations between townhouses. Each townhouse shall be considered a separate building and shall be separated from adjoining townhouses by the use of separate exterior walls meeting the requirements of Table 6.2 for zero clearance from property lines as required for the type of construction, or by a party wall, or when not more than three stories in height, may be separated by a single wall meeting the following requirements:

- (a) Such wall shall provide not less than a 2-hour fire-resistive rating. Plumbing, piping, ducts, electrical or other building services shall not be installed within or through the 2-hour wall, unless such materials and methods of penetration have been tested in accordance with Subsection 1001.1(c).
- (b) Such wall shall be continuous from the foundation to the underside of the roof sheathing. The roof sheathing shall

**TABLE 5.2
REQUIRED FIRE SEPARATIONS IN BUILDINGS OF MIXED OCCUPANCY**

GROUP	A-1	A-2	A-3	A-4	A-5	A-8	B-1	B-2	B-3	B-4	D-1	D-2	D-3	E-1	E-2	E-3	H-1	H-2	H-3	H-4	I-1	I-2	I-3	R-1	R-2	R-3	S-1	S-2	S-3	S-4	S-5	S-8
A-1	N	N	N	N	1	1	1	1	1	1	1	1	1	N	1	1	3	3	2	2	2	1	1	1	1	1	1	2	N	1	N	2
A-2		N	N	N	1	1	1	1	1	1	1	1	1	N	1	1	3	3	2	2	2	1	1	1	1	1	1	2	N	1	N	2
A-3			N	N	1	1	1	1	1	1	1	1	1	N	1	1	3	3	2	2	2	1	1	1	1	1	1	2	N	1	N	2
A-4				N	N	1	1	1	1	1	N	N	N	N	N	N	3	3	2	2	2	1	1	1	1	1	1	2	N	1	N	2
A-5					N	1	1	1	1	1	1	1	1	N	N	N	3	3	2	2	2	1	1	1	1	1	1	2	N	1	N	2
A-8						N	1	1	1	1	1	1	1	N	N	N	3	3	2	2	2	1	1	1	1	1	1	2	N	1	N	2
B-1							N	N	1	1	1	1	1	1	1	1	3	3	2	1	1	1	1	1	1	1	1	2	N	1	N	2
B-2								N	1	1	1	1	1	1	1	1	3	3	2	1	1	1	1	1	1	1	1	2	N	1	N	2
B-3									N	N	1	1	1	1	1	1	3	3	2	1	1	1	1	1	1	1	1	2	N	1	N	2
B-4										N	1	1	1	1	1	1	3	3	2	1	1	1	1	1	1	1	1	2	N	1	N	2
D-1											N	N	1	1	1	1	3	3	2	2	2	2	1	1	1	1	1	2	N	1	N	2
D-2												N	1	1	1	N	3	3	2	2	2	2	1	1	1	1	1	2	N	1	N	2
D-3													N	1	N	1	3	3	2	2	2	2	1	1	1	1	1	2	N	1	N	2
E-1														N	N	N	3	3	3	2	2	2	1	1	1	1	1	2	N	1	N	2
E-2															N	N	3	3	3	2	2	2	1	1	1	1	1	2	N	1	N	2
E-3																N	3	3	3	2	2	2	1	1	1	1	1	2	N	1	N	2
H-1																	N	3	3	3	3	3	3	3	3	3	3	2	N	3	N	2
H-2																		N	3	3	3	3	3	3	3	3	3	2	N	3	N	2
H-3																			N	2	2	2	2	2	2	2	2	2	N	2	N	2
H-4																				N	1	1	1	2	2	2	1	2	N	2	N	2
I-1																					N	1	1	2	2	2	2	2	N	2	N	2
I-2																						N	1	2	2	2	2	2	N	2	N	2
I-3																							N	1	1	1	1	2	N	1	N	2
R-1																								N	N	N	1	2	N	1	N	2
R-2																									N	N	1	2	N	1	N	2
R-3																										N	1	1	N	1	N	1
S-1																											N	1	N	1	N	1
S-2																												N	N	2	N	N
S-3																													N	N	N	N
S-4																														N	N	1
S-5																															N	N
S-8																																N

N = No fire separation required

REQUIREMENTS BASED ON OCCUPANCY

be of noncombustible material or exterior grade fire-retardant-treated wood, or one layer of $\frac{5}{8}$ -inch gypsum wallboard attached to the underside of the roof decking for not less than a 4-foot width on each side of such wall.

- (c) Each dwelling unit sharing such wall shall be designed and constructed to maintain its structural integrity independent of the unit on the opposite side of the wall.

Exception: Said wall may be penetrated by roof and floor structural members provided that the fire-resistance rating and the structural integrity of the wall is maintained.

SECTION 503 REQUIREMENTS APPLYING TO ALL OCCUPANCIES

503.1 Construction, heights and area.

- (a) Buildings or parts of a building classified in a specified occupancy group because of the use shall be limited to the types of construction specified in Subsection 601.1(b) and shall be fire protected as specified in Table 6.2, and shall not exceed the height or area specified in Sections 712, 713 and Table 7.5.
- (b) Buildings having a floor level used for human occupancy located more than 75 feet above the lowest level of fire department vehicle access shall also comply with the requirements of Sections 715, 718 and 810.

503.2 Location and property. Buildings or parts of buildings classified in Group A through R occupancies shall be subject to the requirements of Chapter 7 for protection of exterior walls and openings as determined by location on property and to Table 6.2.

503.3 Exits. Stairways, exits and exit enclosures shall be provided as required in Chapter 8. (For special requirements for exits in high-rise buildings, see Section 810.)

503.4 Occupancy load. The occupant load shall be calculated as specified in Chapter 8, Subsection 802.1 and Table 8.1.

503.5 Protection of vertical openings.

- (a) **Exits.** Where enclosures of exits and vertical openings are required, the enclosure shall be constructed in accordance with the requirements of Section 703 and Table 7.2.
- (b) **Elevator and escalator.** For protection of elevator and escalator openings, see EPCOT Standard 5-1.
- (c) **Waste and linen chutes.** In other than Group R-3 occupancies (dwellings), waste and linen chutes shall terminate in rooms separated from the remainder of the building by an occupancy separation having the same fire resistance as required for the shaft enclosure, but not less than 1 hour. Openings into chutes shall not be located in required exit corridors or in stairways. Construction of waste and linen chutes shall comply with EPCOT Standard 5-14.

503.6 Ceiling heights.

- (a) In all occupancies, ceilings of rooms used for human occupancy and all exitways shall have a clear height of

not less than 7 feet 6 inches measured to the finished floor and lowest projection from the ceiling and shall comply with the *EPCOT Accessibility Code for Building Construction*.

Exceptions:

1. Parking garages and mezzanines may have a minimum ceiling height of 7 feet above the finished floor.
 2. In Group R, kitchens, bathrooms and toilet rooms, storage rooms and laundry rooms may have a minimum ceiling height of 7 feet above the finished floor.
 3. For areas with sloped ceiling, the prescribed ceiling height for the rooms is required in one-half of the area thereof. Any portion of the room measuring less than 5 feet from the finished floor to the ceiling shall not be included in any computation of the minimum area thereof.
 4. For one- and two-family dwellings, beams or girders spaced not less than 4 feet on center shall be permitted to project not more than 6 inches below the required height.
- (b) Rotary fans without fan blade protection shall provide for not less than 8 feet of clearance from the finished floor level to the bottom side of the unprotected fan blades.

Exception: Fan blades of low-speed residential-type ceiling fans installed within dwelling units or guest rooms shall be located at least 6 feet, 8 inches from the finished floor to the lowest tip of the fan blade or motor housing, whichever is lower.

503.7 Light and ventilation.

- (a) Light and ventilation shall be provided in all rooms used by human beings and shall comply with the requirements of Section 517 and the provisions of this Subsection.
- (b) Except in Group R-3 occupancies, windows and skylights shall have an area of not less than 8 percent of the total floor area of the room. At least one-half of the window area shall be openable.
- (c) Windows shall open onto the street, public space or yard.
- (d) Skylights shall be constructed as required in Subsections 706.3 and 706.4 for glass and plastics, respectively.
- (e) Mechanical and artificial lighting and ventilation may be substituted for natural ventilation and lighting. Such installation shall be made in accordance with the requirements for the *EPCOT Mechanical Code*, the *EPCOT Electrical Code* and Section 517.
- (f) Emergency lighting systems shall be provided as required by Section 813 and this Subsection.
- (g) Where ventilation is provided by mechanical means, fresh air in sufficient quantity to maintain healthful conditions shall be provided to meet the requirements of all state laws. In the absence of such requirements, venti-

lation at least equivalent to the requirements of this Code governing natural ventilation shall be provided, or an approved air circulation and treatment system.

- (h) Where natural ventilation or an approved air-treatment system is not provided, lavatories, toilets, bathrooms and restrooms shall be provided with at least 2 cubic feet of exhaust air per minute per square foot of floor area, with the following exceptions:
 1. For lavatories, toilets, bathrooms and restrooms in one- and two-family dwellings, exhaust air may be reduced to a minimum 1 cubic foot per minute per square foot (cfm/ft²).
 2. For private toilet rooms (including hotel guest rooms) with not more than one water closet and one lavatory, exhaust air is only required when the room is occupied.
 3. Rooms where, by reason of use or occupancy, dust fumes, gases, vapors, odors or other hazardous, obnoxious or injurious impurities exist, shall be provided with adequate additional ventilation to ensure safe and healthful conditions.

503.8 Sanitation.

- (a) Sanitary facilities shall be provided in accordance with the applicable requirements of the *EPCOT Plumbing Code*, the *EPCOT Accessibility Code for Building Construction*, EPCOT Standard 5-2, Subsection 503.9 and this Subsection.
- (b) Floors and walls in toilet rooms of other than Group R-3 occupancies shall have an approved smooth, hard, nonabsorbent surface that extends upward onto the walls at least 5 inches. Walls in toilet compartments and walls within 2 feet of the front and sides of urinals shall be similarly finished to a height of 4 feet.
- (c) Doors and panels of shower and bathtub enclosures shall be constructed of approved shatter-resistant material.
- (d) Glass and plastics used in doors and panels of shower and bathtub enclosures shall be not less than the requirements of Section 1005.
- (e) Toilet rooms shall not open directly into a kitchen or room used for the preparation of food for service to the public.
- (f) Every toilet room shall have windows as specified for habitable rooms providing in no case less than 3 square feet of open space, or shall have approved equivalent mechanical ventilation.

503.9 Facilities for people with physical disabilities. All buildings available for public access as defined in Chapter 2 shall be provided with facilities for the physically disabled as required in Chapter 8, this Subsection and the *EPCOT Accessibility Code for Building Construction*.

503.10 Weather protection.

- (a) Where weather protection is required in an occupancy, such protection shall be applied in accordance with the requirements of this Subsection.

- (b) Asphalt-saturated felt, free from holes and breaks and weighing not less than 15 pounds per 100 square feet, or approved water-repellent paper shall be applied over studs or sheathing of all exterior walls. Such felt or paper shall be applied as for weather board, lapped not less than 2 inches at horizontal joints and not less than 6 inches at vertical joints.
- (c) Building paper may be omitted in the following cases:
 1. Where there is no human occupancy.
 2. When exterior covering is of approved weather-protected panels.
 3. In back-plastered construction.
 4. Over water-repellent panel sheathing.
 5. Under approved paperbacked metal or wire fabric lath.
 6. Under metal lath, wire lath or wire fabric on non-combustible construction.
- (d) Exterior openings exposed to the weather shall be caulked, flashed or counterflushed to make them water repellent.

503.11 Guardrails. All enclosed floor and roof openings; operable windows in exterior walls whose sill height is less than 30 inches above the floor below and more than 30 inches above grade; open and glazed sides of landings; and ramps, stairs, balconies or porches, which are more than 30 inches above grade, or a floor below and all publicly accessible docks regardless of water level shall be protected by a guardrail. Guardrails shall form a vertical protective barrier not less than 42 inches high. Open guardrails shall have intermediate rails or ornamental pattern such that a 4-inch-diameter sphere cannot pass through any opening. A bottom rail or curb shall be provided that will reject the passage of a 2-inch-diameter sphere. Construction of guardrails shall be adequate in strength, durability and attachment for their purpose as described in Subsection 902.2(h). Glass used in guardrails shall comply with Subsection 1005.8.

Exceptions:

1. Guardrails need not be provided on the loading side of loading docks.
2. Guardrails for one- and two-family residences shall be a minimum of 36 inches high.
3. Guardrails on a balcony, loge or gallery immediately in front of the first row of fixed seats and which are not at the end of an aisle shall be not less than 26 inches high. Guardrails 42 inches high and the width of the aisle shall be located at the front edge of a balcony, loge or gallery where the aisle terminates. When the slope of the aisle is less than 1:8, the guardrail shall be 42 inches high where the aisle terminates.
4. In assembly seating areas, guards at the end of aisles where they terminate at a fascia of boxes, balconies and galleries shall not have openings which allow passage of a sphere 4 inches in diameter up to a height of 26 inches. From a height of 26 inches to 42 inches above the adjacent walking surfaces, guards shall not

have openings which allow passage of a sphere 8 inches in diameter.

5. A guardrail shall not be required at the front of any stage and enclosed platforms.
6. For areas not accessible to the public, including catwalks and mechanical areas, the clear distance between rails, measured at right angles to the rails, shall not exceed 18 inches.
7. Guardrails shall not be required along vehicle pits when the depth of the pit is less than 48 inches.
8. The triangular openings formed by the riser, tread and bottom rail at the open side of a stairway, shall be a maximum size such that a sphere of 6 inches in diameter cannot pass through the opening.
9. Docks where access is restricted or where space is dedicated for mooring of boats.

503.12 Fire protection and special systems.

- (a) A complete automatic sprinkler system shall be installed in locations as specified in Subsection 715.4.
- (b) Every building greater than 400 square feet not provided with automatic sprinkler protection throughout shall be provided with approved product of combustion detectors located in accordance with EPCOT Standard 7-20. Each detector shall be connected to an AC power source and shall be connected to a central monitored station, if available. If a central monitored station is not available, an outside audible alarm shall be installed subject to approval by the Building Official. Every building in which sleeping areas are provided shall have product of combustion detectors located in accordance with Subsection 513.4 and EPCOT Standard 7-20.
- (c) A fire alarm detection and evacuation system in accordance with NFPA 72 shall be installed in all occupancies.

Exception: A fire alarm detection and evacuation system is not required in Group A-7, R-3, S-1, S-4, S-5, S-6 and S-7 occupancies, temporary occupancies less than 300 occupants, construction trailers for the duration of the construction project, and manufactured buildings less than 3,200 square feet.

- (d) Portable fire extinguishers shall be provided in all occupancies, including temporary structures, in accordance with NFPA 10.

Exception: S-6 Occupancies.

- (e) Where required by occupancy, design or other provisions of this Code, the following systems and services shall be installed:
 1. Automatic sprinkler systems, fire alarms, standpipes, water supply and hose connections shall be installed as required in Section 715.
 2. Air-conditioning systems, chimneys, flues, vents and heat-producing equipment shall be designed as specified in the *EPCOT Mechanical Code*, and the applicable requirements of the *EPCOT Plumbing Code* and the *EPCOT Fuel Gas Code*.

3. Service of hazardous utilities shall be as specified by Subsection 708.3.
4. Every building shall have an approved outside gas shutoff valve.
5. Electrical installations shall be as specified in the *EPCOT Electrical Code*.
6. Elevators, escalators, dumbwaiters, manlifts and transporting assemblies shall be installed, tested, inspected, maintained and operated in accordance with the requirements of EPCOT Standard 5-1.
7. Except where prohibited, the storage of flammable materials shall comply with the requirements of EPCOT Standards 5-4, 5-5 and 5-6.
8. Blower and exhaust systems, where required, shall be installed as specified in EPCOT Standard 5-7.

503.13 Carbon monoxide protection. Every separate building or an addition to an existing building for which a permit for new construction is issued and having a fossil-fuel-burning heater or appliance, a fireplace, an attached garage, or other feature, fixture, or element that emits carbon monoxide as a byproduct of combustion shall have an operational carbon monoxide alarm installed in accordance with NFPA 720 within 10 feet of each room used for sleeping purposes in the new building or addition, or at such other locations as required by this Code.

503.13.1 Carbon monoxide alarm. The requirements of this Section shall be satisfied by providing for one of the following alarm installations:

1. A hard-wired carbon monoxide alarm.
2. A battery-powered carbon monoxide alarm.
3. A hard-wired combination carbon monoxide and smoke alarm.
4. A battery-powered combination carbon monoxide and smoke alarm.

503.13.2 Combination alarms. Combination smoke/carbon monoxide alarms shall be listed and labeled by a Nationally Recognized Testing Laboratory.

Exceptions:

1. An approved operational carbon monoxide detector shall be installed inside or directly outside of each room or area within a hospital, inpatient hospice facility or nursing home facility licensed by the Agency for Health Care Administration, or a new state correctional institution where a fossil-fuel burning heater, engine or appliance is located. The carbon monoxide detector shall be connected to the fire-alarm system of the hospital, inpatient hospice facility or nursing home facility as a supervisory signal.
2. This Section shall not apply to existing buildings that are undergoing alterations or repair unless the alteration is an addition. For the purpose of this Section only, an addition is defined as an extension or increase in floor area, number of stories or height of a building or structure.

503.14 Tents and air-supported structures. Structures used in connection with an occupancy for temporary shelter of persons, material or equipment, shall comply with the applicable provisions of EPCOT Standard 5-8 and Appendix N. Air-supported structures shall be designed and erected in accordance with Appendix N.

503.15 Motion picture projection rooms.

- (a) Equipment used in motion picture projection rooms shall be listed or approved equipment as defined in Appendix G.
- (b) Where a ribbon-type cellulose acetate film is used, or other safety film is used in conjunction with electric arc, Xenon or other light-source projection equipment, projection rooms shall be constructed as required in Appendix G, Part 2 (see Sections G-501 and G-601). The use, storage and (or) handling of cellulose nitrate film is prohibited.

503.16 Spandrel walls. For requirements covering spandrel walls, see Subsection 707.3(b).

503.17 Foam plastic. For requirements regarding the use of foam plastics, see Section 717.

503.18 Boiler rooms and central heating equipment.

- (a) Note: For purposes of this Subsection, a boiler is defined as any vessel used for generating steam and central heating equipment as any furnace or water heater with input greater than 1 million British thermal units (Btu).
- (b) Every room containing central heating equipment with an aggregate input capacity of 1 million Btu or more, installed in any building other than a one- or two-family dwelling, shall be enclosed and separated from the rest of the building by walls, partitions, floors and ceiling of not less than 1-hour fire-resistant construction. Self-closing or automatic-closing protectives having a 1-hour fire-resistive rating shall be installed in all openings. Not more than two central heating boilers and furnaces shall be permitted in any one tenancy in any building unless all are enclosed and separated by walls, partitions, floors and ceilings of 1-hour fire-resistant construction. [See Subsection 511.5(c) for boiler room requirements in Group H occupancies.]
- (c) Every steam boiler carrying more than 15 pounds per square inch (psi) of pressure with a rating in excess of 10 boiler horsepower, installed in a building other than one of Group S occupancy, shall be located in a separated room or compartment, shall not be located under a means of egress, and shall be separated from the rest of the building by walls or partitions having at least 2-hour fire resistance and by floor-ceiling construction having not less than 2-hour fire resistance, provided, however, that when, in the opinion of the Building Official, it is desirable to provide for the venting of a possible explosion upward, this rating may be reduced in accordance with the hazard existing.
- (d) All boiler rooms shall be located on an exterior wall of a building with at least one exit door on the exterior wall. (See Subsection 803.1 for other exit requirements.)

- (e) When the opening for a heater room or equipment room is protected by a pair of fire doors, the inactive leaf shall be secured in the closed position and shall be openable only by use of a tool. An astragal shall be provided and the active leaf shall be self-closing.
- (f) Where oil-fired equipment is used, a 6-inch-high non-combustible curb (dike) shall be provided.

503.19 Membrane structures. See Appendix N.

503.20 Solid wall structures. Buildings or structures of solid wall construction used for a duration of 90 days or less shall comply with Appendix N.

SECTION 504 GENERAL REQUIREMENTS— GROUP A OCCUPANCIES

504.1 Definition. An assembly building is a building or part of a building used for the gathering together of 50 or more persons for such purposes as deliberation, worship, amusement, entertainment, awaiting transportation, drinking or dining.

504.2 Group A occupancies classified. Group A occupancies shall be classified in Subsection 501.1, Table 5.1 and as follows:

Group A – Assembly

- A-1 Assembly buildings with a stage; occupant load of 1,000 or more.
- A-2 Assembly buildings with a stage; occupant load of 50 or more, but less than 1,000.
- A-3 Motion picture theaters; occupant load of 50 or more.
- A-4 Churches, places of worship or religious assembly; occupant load of 50 or more.
- A-5 Assembly rooms; occupant load of 50 or more, including but not limited to: multipurpose rooms, restaurants, nightclubs, dance halls, bowling lanes, drinking or dining establishments, assembly areas contiguous to bus or train depots or airports, libraries and museums.
- A-6 Stadiums and grandstands not classified in other divisions of Group A.
- A-7 Temporary grandstands.
- A-8 Studios, motion picture and television soundstages.

504.3 Scope. Group A occupancies shall meet the requirements of Sections 501, 502, 503 and all other applicable requirements of this Code, and the provisions of Subsections 505.1 through 506.4, which follow.

SECTION 505 SPECIAL REQUIREMENTS— GROUP A-1 AND A-2 OCCUPANCIES

505.1 Scope. In addition to the requirements of Sections 517 and 816; Subsections 501.1 to 504.3; and Tables 5.1 and 5.2, occupancies classified as Group A-1 or A-2 shall conform to the requirements of this Section.

505.2 Location on property. Buildings housing Group A, Division 1 and 2 occupancies, shall front directly on or have

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access to a public street not less than 30 feet wide. The access to the public street shall be a minimum of 30 feet wide, unobstructed right-of-way maintained only as access to the public street. The main entrance to the building shall be located on a public street or access way. (For fire-resistive protection of exterior walls and openings as determined by location on property, see Table 6.2 and Section 701.)

505.3 Construction, height and area.

- (a) Buildings or parts of buildings housing Group A, Division 1 occupancies, shall be of Type I or II construction. Heights and areas shall be limited as provided in Table 7.5.
- (b) Where atmospheric separations are used in buildings of Group A-1 or A-2 occupancy with an occupant load of 300 or more, the building shall comply with the requirements of Subsection 510.9.

505.4 Scope. The slope of the main floor of the assembly room shall not exceed 1 in 5.

505.5 Exits. Exitways shall be constructed and fire protected as required in Chapter 8. Exit signs and illumination shall be installed as provided in Chapter 8 and shall meet the requirements of the *EPCOT Electrical Code*.

505.6 Enclosure of exits and vertical openings. Stairways, exits and vertical openings, such as elevator shafts, vent shafts and smoke-protected stairways, shall be enclosed and the enclosure shall meet the requirements of Table 6.2 and Section 703. Buildings housing Group A occupancies that are more than 75 feet high shall also comply with the requirements of Sections 809 and 810 for exit protection and access.

505.7 Theater stages and platforms. Stages and enclosed platforms shall comply with the requirements of Chapter 9 for design, and with Section 715 and Appendix G, Part 1, for construction and fire protection.

SECTION 506 SPECIAL REQUIREMENTS— GROUP A-3 TO A-7 OCCUPANCIES

506.1 Scope. In addition to the requirements of Sections 502 through 504, 517, 816 and 817; and Tables 5.1 and 5.2, occupancies classified in Groups A-3 to A-7 shall comply with the requirements of this Section.

506.2 Location on property. Buildings housing Group A-3 to A-5 occupancies shall front directly on or shall have access to a public street not less than 20 feet wide. The access to the public street shall be a right-of-way not less than 20 feet wide, unobstructed and maintained only as access to the public street. The main entrance to the building shall be located on the public street or on the access way.

506.3 Construction, height and area.

- (a) In Group A, Division 5 occupancies (bowling lanes), the area occupied by the lanes shall be excluded when calculating occupant load and exits.
- (b) A fire-resistive roof-ceiling assembly shall not be required in a one-story building of Type III, IV, V or VI construction.

- (c) Buildings housing Group A, Division 3 to 5 occupancies, with an occupant load of 1,000 or more, shall be fire protected as required in Table 6.2.

506.4 Special requirements—Group A, Divisions 6 and 7.

- (a) Erection and structural maintenance of Group A, Division 6 and 7 structures, shall conform to the requirements of this Code. Where there are no specific requirements, such structures shall provide adequate safety for the loads to which they may be subjected and shall comply with the requirements for fire protection for the type of construction.
- (b) Group A, Divisions 6 (grandstands) and 7 (temporary grandstands), shall comply with the requirements of Table 7.5 for height, area and type of construction.
- (c) When spaces under Group A, Division 6 and 7 occupancies, are used for any purpose, the space shall be separated from all parts of such occupancies, including exits, by walls, floors and ceiling assemblies of not less than 1-hour fire-resistive construction; except that the underside of continuous deck grandstands, when erected outdoors, need not be protected when occupied for public toilets.
- (d) The Building Official may cause Group A, Division 6 and 7 structures, to be reinspected as he believes necessary for the safety of the structure.
- (e) Running tracks in gymnasiums and similar occupancies may be constructed of wood, or of unprotected steel or iron.
- (f) Temporary structures used for public assembly shall be constructed as required in this Code and the *EPCOT Fire Prevention Code*.
- (g) Bleachers and reviewing stands shall comply with Section 817 and shall comply with the accessibility requirements of the *EPCOT Accessibility Code for Building Construction*. Structural requirements shall comply with Chapter 9.

SECTION 507 SPECIAL REQUIREMENTS— GROUP AA OCCUPANCIES

507.1 Group AA occupancies classified. Group AA occupancies shall be amusement rides and devices as defined in EPCOT Standard 5-13.

507.2 Design and construction.

- (a) The design and construction of amusement rides and devices shall be in accordance with the recognized principles of structural, mechanical and electrical engineering, and with the intent of this Code for safety to life from fire and panic. The structures supporting such rides and devices shall provide safety for the loads to which they may be subjected and shall be equipped with approved safety devices.
- (b) Amusement rides and devices shall be constructed, installed and maintained as specified in EPCOT Standard 5-13.

SECTION 508 GENERAL REQUIREMENTS— GROUP B OCCUPANCIES

508.1 Group B occupancies classified.

- (a) Group B occupancies shall be as classified in Subsection 501.1, Table 5.1, Section 818 and as follows:

Group B – Business—Commercial

- B-1 Wholesale and retail stores, malls, mercantile and office buildings with an occupant load of 500 or more.
 - B-2 Wholesale and retail stores, mercantile and office buildings not classified in Group B-1; paint stores without bulk handling, restaurants or places supplying food or drink that accommodate less than 100 people.
 - B-3 Gasoline service stations, automobile parking garages where no repair work is done and where no flammable liquids are used.
 - B-4 Aircraft hangars where no repair work is done, except exchange of parts and maintenance requiring no open flame, welding or the use of highly flammable liquids; open parking garages and structures, heliports and helistops.
- (b) Group B occupancies shall meet the requirements of Sections 501, 502, 503, 712 and 713, and the provisions of this Subsection.
- (c) Escalator openings in Group B occupancies shall not be more than five stories.

508.2 Enclosure of exits and vertical openings.

- (a) Exits shall be enclosed as required in Chapter 8.
- (b) Other vertical openings shall be enclosed as specified in Table 6.2 and Section 703.

508.3 Construction.

- (a) Group B, Division 1 and 2 occupancies, shall comply with the special requirements of Section 506 for Group A, Division 5 occupancies.
- (b) Buildings or parts of buildings housing Group B, Division 1 and 2 occupancies, used for the storage of high-piled stock, shall be constructed as required in Subsection 511.7.
- (c) In Group B, Division 1 and 2 occupancies, adjoining tenants classified in the same occupancy shall be separated from each other by construction meeting the requirements for a 1-hour fire-resistive separation, both horizontally and vertically.
- (d) Group B, Division 3 occupancies, including canopies and supports over gasoline pumps, shall be of noncombustible, 1-hour or heavy timber construction. Canopies may be constructed of approved, plastic material or fire-retardant-treated wood when approved by the Building Official.
- (e) Floors in Group B, Division 3 and 4 occupancies, shall be protected against saturation of oil and other liquids by a smooth, hard finish of noncombustible material.

508.4 Smoke and heat venting. In one-story buildings housing Group B occupancies more than 50,000 square feet in undivided area, smoke and heat vents shall be installed in accordance with the requirements of Section 716.

508.5 Open parking garages.

- (a) Except where specific provisions are made in the following sections, other requirements for Group B shall apply in open parking garages.
- (b) An open parking garage is a structure of Type I, II, III or IV construction more than one tier high when at least 50 percent of the perimeter is open, and when the structure is used exclusively for parking or storing passenger motor vehicles (see Table 5.3).

1. At least 50 percent of the clear height between floors shall be open to the atmosphere for the full length of at least two exterior walls, excluding required stair and elevator walls and structural columns.

Where a skin structure or exterior façade uses perforated or slotted openings applied to the required clear area, the skin or façade must be a minimum of 40 percent open to contribute any amount to the overall openness calculation. The skin structure or façade shall be set out a minimum of 18 inches from the exterior wall surface.

2. The distance from any point on any floor level to an open exterior wall facing on a street, or to other permanently maintained open space at least 20 feet in width extending full width to a street, shall not exceed 200 feet.
3. When such structures are within 10 feet of a common property or building line, they shall be provided with an enclosure wall along the line of not less than 1-hour fire resistance without openings therein, except door openings meeting the requirements of Subsection 704.3 shall be permitted.
4. All floor and roof areas providing for the parking or movement of automobiles shall be provided with pedestrian guardrails in accordance with Subsection 503.11 at all exterior and interior vertical openings when the vertical distance to the ground or surface directly below exceeds 3 feet. Such parking areas shall also be provided with exterior or interior walls or impact guardrails, except at pedestrian or vehicular accesses, capable of withstanding an impact of not less than 150 pounds per lineal foot applied at 18 inches above the floor. Each floor of such structure shall have wheel guards not less than 4 inches in height above the floor with a clear passage of 3 feet between the wheel guard and edge of structure.

- (c) A shaft enclosure is not required for automobile ramps in open parking garages constructed in accordance with this Subsection.

508.6 Enclosed parking garages. Enclosed and basement public parking decks shall be provided with a mechanical ventilation system for each level in accordance with the *EPCOT*

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Mechanical Code. Enclosed garages shall be provided with automatic sprinklers in accordance with Section 715.

**TABLE 5.3
OPEN AUTOMOBILE PARKING STRUCTURES
ALLOWABLE HEIGHTS AND AREAS**

CONSTRUCTION TYPE	ALLOWABLE AREA (square feet per floor)	ALLOWABLE HEIGHT
Type I	No Limit	No Limit
Type II	No Limit	No Limit
Type III	30,000	4 stories or 40 feet
Type IV	160,000	8 stories or 75 feet

508.7 Prohibited uses. The following uses are not permitted within parking garages.

- Automobile repair work.
- Loaded commercial trucks and similar vehicles.
- Partial or complete closing of required openings in exterior walls by tarpaulins or any other means.
- Dispensing of fuel.

508.8 Helistops.

- Helistops may be erected on buildings or at other locations when constructed in accordance with the requirements of this Subsection and EPCOT Standard 5-9. When erected on buildings, helistops shall be designed in accordance with Section 902 for design live and dead loads and as specified in Chapter 10 for materials of construction.
- The touchdown or landing area for helicopters weighing less than 3,500 pounds shall be a minimum of 20 feet by 20 feet in area. The landing area shall be surrounded on all sides by a clear area having a minimum average width at roof level of 15 feet, but with no width less than 5 feet. For helicopters weighing more than 3,500 pounds, special requirements shall be met as determined by the Building Official.
- Helicopter landing areas and the supports therefor on the roof of a building shall be of noncombustible construction. Landing areas shall be designed to confine any spillage of flammable liquid to the landing area. Provisions shall be made to drain such spillage away from exits and stairways.
- Exits from helistops shall conform to the requirements of Chapter 8.
- Guardrails shall be provided around all roofs or decks and shall comply with the requirements of Subsections 503.11 and 902.2.
- Before operating helicopters from rooftops is permitted, written approval of the Federal Aviation Agency shall be presented to the Building Official.

SECTION 509 GENERAL REQUIREMENTS— GROUP D OCCUPANCIES

509.1 Group D occupancies classified.

- Group D occupancies shall be as classified in Subsection 501.1, Table 5.1, Section 819 and as follows:

Group D – Detention and hospitalization

- Mental hospitals, mental sanitariums, jails, prisons, reformatories; buildings where personal liberties are restrained.
- Hospitals, sanitariums, nursing homes with nonambulatory patients; nurseries for full-time care of children under kindergarten age, each accommodating more than five persons.
- Nursing homes for ambulatory patients, homes for children over kindergarten age, each accommodating more than five persons.

- Buildings housing Group D occupancies shall meet the requirements of Sections 501, 502 and 503; Chapter 8; EPCOT Standard 5-2; and the *EPCOT Fire Prevention Code*, and the provisions of this Section.

509.2 Construction, height and area.

- Buildings housing Group D, Division I occupancies, shall be of Type I or II construction. One-story buildings of Type III 1-hour, Type IV 1-hour or Type V 1-hour may be permitted when the floor area is not more than 3,900 square feet between separation walls of 2-hour fire-resistive construction with all openings protected. The opening protectives shall have 1½-hour fire-resistive rating. Thresholds and expansion joint covers shall be flush with the floor.
- Ceilings in corridors, patients' areas, nurses' stations, labor rooms, nourishment stations and dining areas shall be acoustically treated in accordance with the requirements of EPCOT Standard 5-2.
- Where personal liberties are restrained within the building, the floors shall be of noncombustible material.
- Requirements for the control of sound transmission in Group D, Division 1 and 2 occupancies, shall be as specified in Table 5.4. Location of ductwork, fire blocking, electrical receptacles and other recessed wall attachments shall not interfere with the effectiveness of required sound insulation.

**TABLE 5.4
CONTROL OF SOUND TRANSMISSION
IN GROUP D OCCUPANCIES**

LOCATION	SOUND TRANSMISSION PARTITIONS	CLASS ^a FLOORS
Patient's room to patient's room	45	45
Corridor to patient's room	40	45
Public areas to patient's room ^b	50	50
Service areas to patient's room ^c	55	55

- Sound transmission class determined in accordance with EPCOT Standard 5-10.
- Public areas include lobbies, dining rooms, recreation rooms, treatment rooms and similar areas.
- Service areas include kitchens, elevators, laundries, maintenance rooms, boiler rooms, mechanical rooms and garages.

509.3 Exits.

- Stairways, exits and exit illumination, and smoke-protected enclosures shall be provided as specified in

Chapter 8. For special requirements for exits in Group D occupancies, see Section 819.

- (b) For the incidental accommodation of nonambulatory patients in Group D-3 occupancies, special provisions, such as a first-floor room with direct access to the exterior, shall be provided.

509.4 Enclosure of exits and vertical openings.

- (a) Exits shall be enclosed as required in Chapter 8.
- (b) Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall be constructed as required in Table 6.2 and Section 703.

509.5 Special requirements—Group D occupancies.

- (a) Storage of volatile flammable liquids shall not be permitted in buildings housing Group D occupancies, and the handling of such volatile flammable liquids shall not be permitted in quantities of more than 1 gallon, except when such handling complies with the requirements of EPCOT Standards 5-2, 5-4 and 5-5.
- (b) An approved fire alarm system shall be provided for all Group D, Division 2 occupancies. Audible alarm devices shall be used in all areas where patients are not housed. Visible alarm devices may be used in lieu of audible alarm devices in areas occupied by patients.
- (c) Central heating plant or boilers using solid or liquid fuel shall be protected by a 2-hour fire-resistive separation without openings, except for air-distribution ducts with fire dampers at the plane of the wall. When the fuel used is natural gas, the wall may be a minimum of 1-hour fire-resistive construction.
- (d) Installation of boiler rooms and heating equipment shall be in accordance with the requirements of Subsection 503.17, Table 5.2 and the *EPCOT Mechanical Code*.

SECTION 510 GENERAL REQUIREMENTS— GROUP E OCCUPANCIES

510.1 Group E occupancies classified.

- (a) Group E occupancies shall be as classified in Subsection 501.1, Table 5.1, Section 820 and as follows:

Group E – Educational

E-1 A building or part of a building, or a group of buildings, on one property with an occupant load of 50 or more, used for education, instruction or recreation of pupils from kindergarten (including preschool) through the 12th grade for 12 hours or more per week, or 4 hours or more in any one day, not included in Group A.

E-2 A building or part of a building, or a group of buildings, on one property with an occupant load of 50 or more, used for education, instruction or recreation of pupils from kindergarten (including preschool) through the 12th grade for less than 12 hours per week, or less than 4 hours in any one day, not included in Group B.

E-3 A building or part of a building used for day care or day nursery care of five children or more.

- (b) Group E occupancies shall meet the requirements of Sections 501, 502 and 503, and the provisions of this Section.

510.2 Location on property.

- (a) Buildings housing Group E occupancies shall front on or have access to a public street not less than 20 feet wide.
- (b) The access to the public street shall be not less than 20 feet wide, unobstructed and maintained only as a right-of-way to the public street or access way.
- (c) At least one required exit shall be located on the public street or access way.

510.3 Construction, height and area.

- (a) Buildings or parts of buildings housing Group E occupancies shall be limited to the types of construction specified in Subsection 601.1(b) and Table 6.2, and shall not exceed the limits specified in Sections 712 and 713 for height and area. Where the maximum travel distance required in Subsection 803.4 is reduced by 50 percent, the area limits may be increased by 50 percent.
- (b) Buildings of Type III, IV 1 hour and Type V 1 hour, housing Group E, Division 1 and 2 occupancies, may be two stories when the first and second floors are separated by a 2-hour, horizontal fire-resistive separation with no openings and when each classroom has an exit direct to the exterior of the building.
- (c) Janitor closets shall be of 1-hour fire-resistive construction. Location under required exit stairs shall be prohibited.
- (d) Where buildings housing Group E occupancies are constructed with atmospheric separations, they shall comply with the requirements of Subsection 510.9.

510.4 Accessory occupancies.

- (a) The following accessory uses to Group E, Division 1 occupancies, need not be separated from the primary occupancy:
 1. Assembly rooms, dining rooms, libraries, gymnasiums and multipurpose rooms.
 2. Similar accessory uses as determined by the Building Official.
- (b) Accessory uses not included in Paragraphs 1 and 2 shall comply with the requirements for the principal occupancy.

510.5 Special occupancy separations.

- (a) Vocational shops, laboratories, mechanical equipment rooms, machine shops, storage rooms and similar areas shall be separated from each other and from classrooms by not less than 1-hour fire-resistive occupancy separations as defined in Section 502.
- (b) Balconies and bleachers over usable spaces shall be protected by a 1-hour fire-resistive occupancy separation as defined in Section 502.

510.6 Exits. Stairways, exits and vertical openings shall be constructed as required in Chapter 8.

510.7 Enclosure of exits and vertical openings.

- (a) Stairways and exits shall be enclosed as specified in Chapter 8 and the enclosures shall be constructed as required in Section 703.
- (b) Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosures shall be constructed as required in Table 6.2, Section 703 and EPCOT Standard 5-1.

510.8 Special requirements—Group E occupancies.

- (a) In addition to the requirements of Subsections 503.12 and 510.9, where applicable, the requirements of this Subsection shall apply to fire safety in Group E occupancies.
- (b) Storage of volatile flammable liquids shall be limited to approved amounts required for maintenance, demonstration and laboratory use, and the storage and handling of such materials shall be in accordance with the requirements of EPCOT Standards 5-4, 5-5 and 5-6.
- (c) Approved fire alarm systems shall be provided in all Group E occupancies with an occupant load of 50 or more. In Group E occupancies equipped with an approved automatic sprinkler system, the operation of the systems shall automatically activate the school fire alarm, which shall include an alarm mounted on the exterior of the building.
- (d) Stages and platforms in Group E, Division 1 occupancies, shall be constructed as required in Appendix G, except that platforms that are part of a classroom and do not occupy more than 15 percent of the floor area may be constructed of combustible material.
- (e) Proscenium curtains shall be noncombustible or fire resistive as required in Appendix G, Part 1.
- (f) Gymnasiums, auditoriums, multipurpose rooms and similar occupancies shall comply with the requirements of this Code for Group A occupancies.

510.9 Special requirements for atmospheric separations.

- (a) **Scope.** The requirements of this Subsection shall comply only to requirements for providing separate atmospheres in Group E, Division 1 and 2 occupancies, and in Group A where the occupant load is more than 300. (See Subsection 502.3.)
- (b) **Definitions.** The following definitions are applicable to the requirements of this Subsection.
 - 1. **Common atmosphere.** A common atmosphere exists between rooms, spaces or areas within a building that are not separated by an approved smoke and draftstop barrier.
 - 2. **Separate atmosphere.** A separate atmosphere exists between rooms, spaces or areas that are separated by an approved smoke or draftstop barrier.
 - 3. **Smoke and draftstop barrier.** A smoke and draftstop barrier consists of walls, partitions,

floors and openings of construction that will prevent transmission of smoke or gases through the construction. The minimum requirement for such a barrier is that it endure a 20-minute fire exposure as established in EPCOT Standard 6-1.

- (c) **Construction.** Walls, partitions and floors forming all or part of an atmosphere separation shall be of materials consistent with the requirements for the type of construction, but shall be of construction no less effective than a smoke or draftstop barrier as defined in Paragraph (b). Glass lights of approved wire glass set in steel frames may be installed in such walls or partitions. Every door opening therein shall be provided with an opening protective as required elsewhere in this Code, but not less than a self-closing or automatic-closing, tight-fitting smoke or draftstop assembly having a fire-protective rating of not less than 20 minutes when tested in accordance with the requirements of EPCOT Standard 6-1, Part 1.
- (d) **Fire protection and special systems.** In addition to or in lieu of the requirements of Subsections 503.12 and 510.8, the requirements of this Paragraph apply to Group E occupancies where atmospheric separations are used:
 - 1. Ducts penetrating atmospheric separation walls, partitions or floors shall be equipped with an approved automatic-closing smoke damper when the ducts open into more than one atmosphere.
 - 2. Automatic-closing opening protectives installed in the atmospheric separation shall be activated by approved detectors of products of combustion other than heat.
 - 3. Rooms or groups of rooms in which flammable liquids, combustible dust or similar hazardous materials are used, developed, stored or handled shall be separated from other parts of the building by not less than a 1-hour fire-resistive occupancy separation as classified in Subsection 502.3.
 - 4. Rooms or groups of rooms sharing a common atmosphere, in which flammable liquids, combustible dust or similar hazardous materials are used, stored, developed or handled to a degree in excess of the requirements of this Code, shall be protected by an approved automatic sprinkler system as specified in Section 715.
 - 5. Equipment rooms or groups of rooms sharing a common atmosphere where flammable liquids, combustible dust or similar hazardous materials are used, stored, developed or handled shall conform to the requirements of the *EPCOT Fire Prevention Code*.

The specific requirements of this Subsection are not intended to prevent the design and use of other systems, equipment or techniques that will effectively prevent the products of combustion from breaching the atmospheric separation.

SECTION 511 GENERAL REQUIREMENTS— GROUP H OCCUPANCIES

511.1 Group H occupancies classified.

- (a) Group H occupancies shall be as classified in Subsection 501.1, Table 5.1, Section 821 and as follows:

Group H – Hazardous

H-1 Buildings or parts of buildings used for storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids.

H-2 Dry cleaning plants, paint stores with bulk handling, paint shops and other uses requiring the storage and handling of Class I, II or III flammable liquids.

H-3 Woodworking establishments, planing mills and box factories; shops and factories where loose, combustible fibers are manufactured or processed or where dust is generated; warehouses where highly combustible materials or high-piled stock are stored or kept.

H-4 Garages and aircraft hangars where maintenance and repair work is done.

- (b) Group H occupancies shall meet the requirements of Sections 501, 502, 503 and 821, and the provisions of this Section.
- (c) Buildings housing less than the amounts of hazardous materials as specified in Table 5.5 shall be exempt from classification as Group H occupancies unless so classified by other requirements of this Code.
- (d) The following uses shall not be classified as Group H occupancies, except as required by other provisions of this Code:
1. Buildings containing less than the amounts of hazardous materials specified in Table 5.5.
 2. Rooms containing flammable liquids in tightly closed, approved containers of 1 gallon or less capacity for retail sale or private use on the premises and in quantities not more than 2 gallons per square foot of room area.
 3. Rooms used in preparation or storage of food products for retail sale on the premises.
 4. Rooms where flammable liquids are dispensed, used or stored as incidental to a Group A-5 or B occupancy.
 5. Drug stores.
 6. Hardware stores.
 7. Retail paint stores with quantities of paint not more than 2 gallons per square foot of room area.
 8. Retail liquor stores.
 9. Agricultural property where combustible or flammable materials are stored for use on the property.

TABLE 5.5
EXEMPT AMOUNTS OF HAZARDOUS MATERIALS

HAZARDOUS MATERIALS	EXEMPT AMOUNTS OF STORAGE MANUFACTURE, PROCESS OR USE OF HAZARDOUS MATERIALS
Flammable liquids Class 1-A Class 1-B Class 1-C Class II	60 gallons 120 gallons 180 gallons 240 gallons
Combustible liquids	500 gallons
Combination flammable liquids ^a	240 gallons
Flammable gases	3,000 ft ³ at one atmosphere of pressure at 70°F
Liquid flammable gases	60 gallons
Flammable dusts	See the <i>EPCOT Fire Prevention Code</i>
Flammable fibers—loose	100 ft ³
Flammable fibers—baled	1,000 ft ³
Flammable solids	500 lbs.
Dangerous chemicals	See the <i>EPCOT Fire Prevention Code</i>
Unstable materials	No exemption

a. Containing not more than the exempt amounts of Class 1-A, 1-B and 1-C flammable liquids.

511.2 Construction, height and area.

- (a) In Group H, Division 1 and 2 occupancies, one wall of the occupancy shall be an exterior wall to provide explosion venting. Accessory Group H-1 and H-2 occupancies, meeting the requirements of Subsection 502.1(c), shall be placed on the perimeter of the building so that the explosion venting is directly to the outside. The venting shall have a minimum of 25 percent of the exterior wall of the Group H occupancy, unless specifically approved by the Building Official.
- (b) Smoke and heat vents shall be installed in Group H occupancies with more than 15,000 square feet in a single floor, and such vents shall be installed in accordance with the requirements of Section 716.
- (c) Aircraft hangars where maintenance and repair work is done shall have exterior walls of not less than 1-hour fire-resistive construction, or shall be surrounded by public space, streets or permanent yards not less than 60 feet wide. Area increases permitted in Section 712 shall be not more than 50 percent for aircraft hangars.
- (d) In Group H, Division 4 occupancies, where flammable or explosive liquids are stored or kept, floors shall be protected against saturation by noncombustible materials.
- (e) The structural frame of the buildings housing Group H occupancies more than 95 feet high shall be protected by not less than 3-hour fire-resistive construction and the floor assembly shall be of not less than 3-hour fire-resistive construction.

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511.3 Exits. Stairways, exits and smoke-protected enclosures shall be provided as specified in Chapter 8. (See Section 821.)

511.4 Enclosure of exits and vertical openings. Stairways and exits shall be enclosed as specified in Chapter 8. Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall have the fire-resistance specified in Table 6.2 and Section 703.

511.5 Special requirements—Group H occupancies.

- (a) The use, handling and storage of gasoline, fuel oil and other flammable liquids shall comply with the requirements of EPCOT Standards 5-4, 5-5 and 5-6.
- (b) Dry cleaning plants shall be limited to the use of solvents with a flash point above 140°F and shall comply with the requirements of EPCOT Standard 5-6 for Class III dry cleaning plants.
- (c) Every boiler room or room containing a heating plant shall be separated from other parts of the building by a 3-hour fire-resistive separation as defined in Section 502. There shall be no interior openings between the Group H occupancy and a boiler room, furnace room or incinerator room.
- (d) In Group H, Division 4 occupancies, space heaters shall comply with the requirements of the *EPCOT Mechanical Code*.
- (e) Every building housing a Group H occupancy shall be provided with an approved outside gas shutoff valve, conspicuously marked. (See the *EPCOT Fuel Gas Code*.)
- (f) Each machine used in a dry cleaning shop using volatile flammable liquid shall have a steam line connected directly to it, arranged so that the steam will be released automatically to the inside when an explosion occurs in a machine. (See the *EPCOT Fire Prevention Code*.)

511.6 Paint spraying and dipping booths. Where an approved spray booth is installed in a building housing a Group H occupancy, in accordance with the requirements of EPCOT Standard 5-11, such booth need not be separated from other Group H and I occupancies.

511.7 High-piled stock.

- (a) Buildings used or intended to be used for the storage of high-piled stock as defined in Paragraph (b) shall comply with the requirements of this Subsection.
- (b) High-piled stock shall be combustible commodities or packaging materials that are placed in closely packed piles more than 12 feet high, or that are highly combustible materials placed in piles, stacks or racks more than 6 feet high.

Combustible commodities include the following classifications:

- 1. Manufactured combustible materials.
- 2. Wrapped or packaged in or protected by combustible materials.
- 3. Stored on combustible pallets or racks.

Highly combustible commodities include the following:

- 1. Rubber goods.
 - 2. High-hazard foam plastic products.
 - 3. Other materials that are subject to rapid combustion.
- (c) In rooms containing high-piled stock, ceilings shall be divided into areas not more than 20,000 square feet by approved noncombustible draftstops, constructed as required in Subsection 705.5, extending at least 2 feet below the ceiling. In lieu of draftstops, curtain boards and roof vents may be installed as provided in Section 716 and EPCOT Standard 7-9.
 - (d) In buildings containing an area of more than 10,000 square feet of high-piled stock, access shall be provided on both sides of the area. Doorways 3 feet wide and 6½ feet high, located in exterior walls at intervals not more than 100 feet, shall be considered sufficient, except where steel roll-up doors or other types of doors are used that obstruct the access.

SECTION 512 GENERAL REQUIREMENTS— GROUP I OCCUPANCIES

512.1 Group I occupancies classified.

- (a) Group I occupancies shall be as classified in Section 501, Table 5.1 and as follows:

Group I – Industrial

- I-1 Power plants, pumping stations, cold-storage buildings, creameries and ice plants.
 - I-2 Factories and warehouses wherein materials other than highly combustible are used, processed or stored; or where high-piled stock is warehoused, stored, used or processed.
 - I-3 Maintenance workshops and laboratories.
- (b) Group I occupancies shall comply with the applicable requirements of Sections 502 and 503, and with the provisions of this Section and Chapter 8.

512.2 Construction and fire protection.

- (a) In Group I-2 occupancies where high-piled stock is stored as described in Section 511, construction shall be in accordance with Paragraphs (c) and (d) of Subsection 511.7.
- (b) Fire protection of the underside of the roof framing may be omitted in buildings housing Group I occupancies.

512.3 Enclosure of openings.

- (a) Interior stairways, ramps and escalators serving Group I occupancies shall be enclosed as specified in Chapter 8, and the enclosure shall be fire protected as required in Table 6.2 and Section 703.

- (b) Transporting assemblies shall be fire protected as required in Chapter 7, and shall be constructed and operated in accordance with the requirements of EPCOT Standard 5-1 and the rules and regulations of Florida Statute 442. (For fire protection of conveyer openings, see EPCOT Standard 7-6.)

512.4 Special requirements—Group I occupancies. In addition to the requirements of Subsection 503.12, the following requirements for fire safety shall apply to Group I occupancies:

- (a) Storage, use and handling of gasoline, fuel oil and other flammable liquids shall conform to the requirements of EPCOT Standards 5-4, 5-5 and 5-6. In rooms where volatile flammable liquids are used or stored, no device generating a glow or flame capable of igniting gasoline vapor shall be installed or used within 24 inches of the floor.
- (b) Transformer vaults shall be constructed in accordance with the requirements of the *EPCOT Electrical Code*.
- (c) In one-story buildings housing Group I-2 occupancies, with more than 50,000 square feet in undivided areas, smoke and heat vents shall be installed in accordance with the requirements of Section 716.

SECTION 513 GENERAL REQUIREMENTS— GROUP R OCCUPANCIES

513.1 Group R occupancies classified.

- (a) Group R occupancies shall be classified in Section 501, Table 5.1 and as follows:

Group R – Residential

R-1 Hotels, motels and similar facilities having three or more rooms for transient guests.

R-2 Multiple-residential apartment houses, convents, monasteries, dormitories, guest houses and facilities having three or more permanent residential units.

R-3 Dwellings of one and two units.

- (b) Group R occupancies shall comply with the applicable requirements of Sections 501 through 503 and 822, and this Section.

513.2 Special construction requirements.

- (a) In Group R occupancies of more than a single dwelling, walls, partitions and floor-ceiling construction separating individual units from each other or from public halls, corridors or stairs, shall have a minimum sound transmission class rating of 45 in accordance with EPCOT Standard 5-10 for airborne noise. This requirement shall not apply to entrance doors of individual units. Verification of the sound transmission class shall be test data by an approved testing laboratory in accordance with the requirements of EPCOT Standard 5-10.
- (b) Tenant separations shall be provided between units of Group R-1, R-2 and R-3 occupancies in accordance with Subsection 502.5.

513.3 Ventilation and sanitation. Ventilation and sanitation shall be provided as required in Subsections 503.7 and 503.8 and Section 517, and as specified in the *EPCOT Mechanical Code* and the *EPCOT Plumbing Code*.

513.4 Fire detection systems. An approved detector of the products of combustion other than heat shall be installed in every dwelling and every dwelling unit within an apartment house, condominium, townhouse and every guest room in a motel or hotel. Every single- and multiple-station smoke detector shall be connected to an AC power source. Detectors shall comply with the requirements of EPCOT Standard 7-4 and this Subsection, and shall be installed in accordance with the manufacturer's recommendations and listings. When activated, the detector shall sound a local audible alarm.

Exception: In existing buildings, a monitoring battery source is permitted.

513.5 Fire-extinguishing systems. Automatic fire-extinguishing systems required by this Code shall be installed in accordance with Section 715 and EPCOT Standards 7-10 through 7-13.

513.6 Separation of garages.

- (a) A separation between a private garage and a dwelling shall be a minimum of 1-hour fire resistance, except in the case of a Group R-3 occupancy. (See Subsection 515.3.)
- (b) Attached garages shall not open directly into a sleeping area.

SECTION 514 SPECIAL REQUIREMENTS— GROUP R-1 AND R-2 OCCUPANCIES

514.1 Protection of openings. Exits, smoke-protected stairways and other vertical openings shall be enclosed and the enclosure shall be as specified in Section 703 and Chapter 8 for vertical openings and exits, respectively. (See Subsection 809.1.)

SECTION 515 SPECIAL REQUIREMENTS— GROUP R-3 OCCUPANCIES

515.1 Scope. Group R, Division 3 occupancies, shall meet the applicable requirements of Sections 501, 502, 503, 513, 822 and this Section.

515.2 Protection of vertical openings. Dumbwaiter shafts, clothes chutes, trash chutes and other vertical openings shall be enclosed as required in Section 703.

515.3 Separation of garages.

- (a) A dwelling and an attached garage shall be separated from the floor to the roof with a fire-resistive wall with the membrane on the garage side, complying with that portion of a 1-hour tested assembly with no openings in the wall. A self-closing, tight-fitting solid wood core door or the equivalent, not less than 1³/₈ inches thick, may be permitted by the Building Official.
- (b) Attached garages shall not open directly into a sleeping room.

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515.4 Stair enclosures. Where stairways are required to be enclosed, the enclosure shall be as specified in Section 809.

SECTION 516 GENERAL REQUIREMENTS— GROUP S OCCUPANCIES

516.1 Group S occupancies classified.

- (a) Group S occupancies shall be as classified in Section 501, Table 5.1 and as follows:

Group S – Satellite structures

- S-1 Private garages, carports, greenhouses, sheds, cabanas, bath houses, agricultural buildings, shade structures and guard shacks.
 - S-2 Commercial stables.
 - S-3 Swimming pools.
 - S-4 Mobile homes, campers and trailers.
 - S-5 Tanks and towers located above ground that support their own weight.
 - S-6 Fences as defined in Chapter 2.
 - S-7 Docks.
 - S-8 Animal support facilities.
 - S-9 Street lighting, signage, lift stations, electrical vaults or structures associated with roadway right-of-way.
- (b) Group S occupancies shall meet the applicable requirements of Sections 502 and 503, Chapter 8, and the provisions of this Section.
- (c) Group S structures shall be designed to support their own live and dead loads, and wind loads as required in Chapter 9.
- (d) Group S-2 occupancies shall comply with the requirements of Appendix H.
- (e) Group S-3 occupancies shall comply with the requirements of Appendix E.
- (f) Group S-4 occupancies shall comply with the requirements of Appendix J.
- (g) Group S-8 occupancies shall comply with the requirements of Appendix Q.
- (h) Group S-9 occupancies shall comply with the requirements of Appendix D and/or the *EPCOT Electrical Code*.

516.2 Construction, height and area.

- (a) In a building of mixed occupancy, the total area of private garages used exclusively for parking of passenger motor vehicles may be 3,000 square feet when the exterior walls and openings are protected as required for the primary occupancy of the building. Each part of a building separated as specified in Section 502 may be considered to be a separate building. Increases in area may apply to a building of single occupancy when the use of the building is as specified and the protection of

exterior walls and openings is as required for a building housing a Group S-1 occupancy.

- (b) When a private parking garage is erected at least 20 feet from the main building, the area of the garage may be 3,000 square feet. When erected less than 20 feet from the main building, the exterior wall facing the main building shall be of 1-hour fire-resistive construction with no openings.
- (c) Separations of garages attached to buildings housing Group S-2 occupancies shall be as required for Group R-3 occupancies in Subsection 515.3(a).
- (d) In areas where motor vehicles are stored or operated, floor surfaces shall be of noncombustible materials or of asphaltic paving materials.

SECTION 517 SPECIAL REQUIREMENTS FOR LIGHT AND VENTILATION—ALL OCCUPANCIES (For Basic Requirements, see Chapter 4 of the *EPCOT Mechanical Code*, the *EPCOT Electrical Code* and the *EPCOT Energy Efficiency Code for Building Construction*)

517.1 Group A and E occupancies.

- (a) Artificial ventilation shall comply with Section 403 of the *EPCOT Mechanical Code*.
- (b) Ventilation of stages and stage dressing rooms shall be as required in Appendix G, Part 1.
- (c) Ventilation of motion picture machine rooms shall be as required in Appendix G, Part 2.

517.2 Group B and I occupancies.

- (a) Artificial ventilation and mechanical systems, installed as required in the *EPCOT Mechanical Code*, shall supply at least two changes of air per hour. The system shall be vented to the outside air. The discharge point shall be located at least 5 feet from an openable window.
- (b) Toilet rooms shall have exterior windows not less than 3 square feet in area, fully openable or a vertical duct not less than 100 square inches in area for the first toilet and not less than 50 square inches for each additional toilet, or shall have an approved mechanical ventilating system, as required in the *EPCOT Mechanical Code*.
- (c) Group B-3 occupancies used for storage and handling of automobiles under their own power may have a mechanically operated exhaust system connected to a light switch, to provide four changes of air per hour, air to be taken from near floor level. In storage garages and airplane hangars greater than 5,000 square feet, the Building Official may waive this requirement when the building is provided with unobstructed openings to the outer air sufficient to supply required ventilation.
- (d) In Group B occupancies where flammable liquids are stored or kept, exhaust ventilation shall be provided sufficient to produce four changes of air per hour, air to be taken from near floor level.

517.3 Group D occupancies.

- (a) Artificial ventilation and mechanical systems shall be installed as required in the *EPCOT Mechanical Code*. The number of changes of air shall be as required in EPCOT Standard 5-2.
- (b) Group D-1 and D-2 heating and ventilating systems shall comply with EPCOT Standard 5-2 and shall provide temperature and humidity ranges as follows:

ROOM DESIGNATION	TEMPERATURE (°F)	HUMIDITY %
Operating	70 – 76 ^a	50 – 60
Delivery	70 – 76 ^a	50 – 60
Recovery	75	50 – 60
Nursery (full-term and observation)	75	50
Nursery (premature)	70 – 80 ^a	50 – 60 ^a
Intensive care	70 – 80 ^a	30 – 60

a. Variable range required.

- (c) Ducts for all mechanical systems shall serve no other occupancy and shall be an approved material.
Emergency lighting systems shall be provided as required in the *EPCOT Electrical Code*.
- (d) All air supply and exhaust systems shall be mechanically operated. Outdoor supply intakes shall not be located closer than 25 feet from exhausts of ventilating systems. The bottom of outdoor intakes serving central systems shall be located not less than 8 feet above the ground level or, if installed through the roof, it shall be not less than 3 feet above roof level.

517.4 Group H occupancies.

- (a) Artificial ventilation and mechanical systems, installed as required in the *EPCOT Mechanical Code*, shall supply at least two changes of air per hour. The system shall be vented to the outside air. The discharge point shall be located at least 5 feet from an openable window.
- (b) In rooms where dust, fumes, vapors, gases or other impurities are present, a mechanical ventilating system shall be provided and the installation shall be in accordance with the *EPCOT Mechanical Code*.
- (c) In buildings where flammable liquids are used, exhaust ventilation shall be provided and shall produce not less than four changes of air per hour, and the air shall be taken from near the floor level.
- (d) Toilet rooms shall have exterior windows not less than 3 square feet in area and shall be fully openable, or a vertical duct having not less than 100 square inches in area for the first toilet and 50 square inches for each additional toilet.
- (e) A mechanical ventilating system installed as required in the *EPCOT Mechanical Code* may be substituted when approved by the Building Official.

517.5 Group R occupancies.

- (a) Artificial ventilation and mechanical systems, installed as required in the *EPCOT Mechanical Code*, shall supply the following changes of air per hour:
 - R-1 and R-2 guest rooms, living rooms 2
 - Kitchens, bathrooms, toilet rooms, laundry rooms 12
 - R-3 bathroom and toilet rooms 12
- (b) Light and ventilation shall be provided in Group R-1 and R-2 occupancies, in accordance with the rules and regulations of the State of Florida. Window area shall be at least 8 percent of the floor area and shall be at least one-half openable.
Exception: Buildings protected throughout by an approved supervised automatic sprinkler system installed in accordance with NFPA 13 and provided with an approved engineered smoke control system with mechanical ventilation system capable of providing at least two air changes per hour in all areas.
- (c) In Group R-3 dwellings, the window area in bathrooms and toilet rooms shall be not less than 3 square feet and at least one-half of the area shall be openable.

517.6 Group S occupancies.

- (a) Where light and ventilation are required in buildings of Group S-1 occupancy, artificial illumination with mechanical systems, installed as required in the *EPCOT Mechanical Code*, may be substituted.
- (b) In buildings of Group S-2 occupancy (commercial stables), mechanical systems may not be substituted for natural ventilation, except as approved specifically by the Building Official.

SECTION 518 SPECIAL CONSTRUCTION

518.1 Children's play structures. Children's play structures installed inside all occupancies covered by this Code shall comply with the following:

- (a) **Materials.** Children's play structures shall be constructed of noncombustible materials or of combustible materials that comply with the following:
 1. Fire-retardant-treated wood.
 2. Light-transmitting plastics complying with Section 1008.
 3. Foam plastics (including the pipe foam used in soft-contained play equipment structures) having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with UL 1975.
 4. Aluminum composite material (ACM) meeting the requirements of Class 1 interior finish in

accordance with Section 711 when tested as an assembly in the maximum thickness intended for use.

5. Textiles and films complying with the flame propagation performance criteria contained in NFPA 701.
 6. Plastic materials used to construct rigid components of soft-contained play equipment structures (such as tubes, windows, panels, junction boxes, pipes, slides and decks) exhibiting a peak rate of heat release not exceeding 400 kW/m² when tested in accordance with ASTM E1354 at an incident heat flux of 50 kW/m² in the horizontal orientation at a thickness of 6 mm.
 7. Ball pool balls, used in soft-contained play equipment structures, having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with UL 1975. The minimum specimen test size shall be 36 inches by 36 inches by an average of 21 inches deep, and the balls shall be held in a box constructed of galvanized steel poultry netting wire mesh.
 8. Foam plastics shall be covered by a fabric, coating or film meeting the flame propagation performance criteria of NFPA 701.
 9. The floor covering placed under the children's playground structure shall exhibit a Class 1 interior floor finish classification, as described in Section 711, when tested in accordance with NFPA 253.
- (b) **Fire protection.** Children's play structures shall be provided with the same level of approved fire suppression and detection devices required for other structures in the same occupancy.
 - (c) **Separation.** Children's play structures shall have a horizontal separation from building walls, partitions and from elements of the means of egress of not less than 5 feet. Children's playground structures shall have a horizontal separation from other children's play structures of not less than 20 feet.
 - (d) **Area limits.** Children's play structures shall not exceed 300 square feet in area, unless a special investigation has demonstrated adequate fire safety.

CHAPTER 6

REQUIREMENTS BASED ON TYPES OF CONSTRUCTION

SECTION 601 CLASSIFICATION, SCOPE AND CRITERIA

601.1 Classification.

- (a) The Building Official shall classify all buildings and structures according to the type of construction set forth in Subsection 601.1(b) and Table 6.2 representing the various degrees of fire resistance in the building. All buildings and parts of buildings hereafter constructed in the District shall conform to the requirements for the specific types of construction as provided in this Chapter, Chapter 7, and as set forth in Subsection 601.1(b) and Table 6.2, and shall comply with the applicable requirements of other Chapters and Sections of this Code.

(b) **Classification of types of construction.**

Type I—Structural elements of approved noncombustible materials, exterior walls of masonry, reinforced concrete or other approved noncombustible materials, fire protected as specified in Table 6.2 and EPCOT Standards.

Type II—Structural elements of approved noncombustible materials or other approved materials, exterior walls of masonry, reinforced concrete or other approved materials, fire protected as specified in Table 6.2 and EPCOT Standards.

Type III—Structural elements of heavy timber (HT), sawn or glued-laminated, or of fire-resistive construction when materials other than heavy timber are used, exterior walls of masonry, reinforced concrete or other approved materials, fire protected as specified in Table 6.2 and EPCOT Standards.

Type IV—Structural elements and exterior walls of approved noncombustible materials may be unprotected or fire protected as specified in Table 6.2 and EPCOT Standards.

Type V—Structural elements and exterior walls of approved materials, may be unprotected or fire protected as specified in Table 6.2 and EPCOT Standards.

Type VI—Structural elements and exterior walls of wood or other approved combustible materials, may be unprotected or fire protected as specified in Table 6.2 and EPCOT Standards.

- (c) Buildings not conforming to a type of construction classified in Subsection 601.1(b) and Table 6.2 shall be classified by the Building Official according to the type having equal or less fire resistance.
- (d) Where two or more types of construction are used in the same building and are separated as required in Chapter 7, each part so separated may be classified in the type of construction to which it conforms; otherwise, the entire

building shall be classified as the least fire-resistive type of construction in the building and shall be subject to the requirements for that type.

601.2 Scope.

- (a) No building or part of a building shall be required to conform to a type of construction that is more restrictive than the minimum type required for occupancy and location.
- (b) Requirements for specific materials, types of construction and fire protection shall be minimum requirements and any material, type of construction or fire protection may be used that affords safety or fire resistance equal to or greater than that provided in this Code.

601.3 Criteria.

- (a) Construction materials, assemblies of materials and systems tested by an approved laboratory, in accordance with Section 311 and EPCOT Standard 6-1, shall be rated according to test results and conditions.
- (b) All types of construction shall comply with the following Chapters and Sections:
1. Structural design—Chapters 9 and 10.
 2. Fire protection of exterior walls and structural elements of buildings—Sections 701, 707 and 708.
 3. Openings in walls (opening protectives)—Section 704.
 4. Enclosure of vertical openings—Section 703.
 5. Fire protection of floors, roofs and ceilings—Section 705.
 6. Penthouses, roof structures and skylights—Section 706.
 7. Fire division walls—Section 708.
 8. Partitions—Section 709.
 9. Veneer—Section 710.
 10. Interior wall, ceiling and floor finish—Section 711.
 11. Maximum floor areas—Section 712 and Table 7.5.
 12. Maximum heights of buildings—Section 713 and Table 7.5.
 13. Fire-extinguishing systems—Subsection 503.12 and Section 715.
 14. Smoke and heat venting—Section 716.
 15. Foam plastics—Section 717.
- (c) In addition to the requirements specified in Subsections 601.1, 601.2 and 601.3, the special provisions of Sections 602 to 606 shall apply.

SECTION 602 SPECIAL REQUIREMENTS— TYPES I AND II CONSTRUCTION

602.1 Floors.

- (a) Where wood sleepers are used in buildings of Types I and II construction for laying wood flooring on noncombustible floors, the furring space shall be filled with noncombustible material or shall be firestopped so that there will be no open space greater than 100 square feet in area under the flooring. Such spaces shall be filled solidly under all permanent partitions to prevent spread of fire under the flooring. (See Subsection 705.2.)
- (b) Mezzanine floors shall be on noncombustible construction as approved for 1-hour fire resistive.

602.2 Roofs. In buildings of Types I and II construction, noncombustible materials shall be protected in accordance with Table 6.2.

Exception: Fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor or ceiling immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

602.3 Stairways. In buildings of Types I and II construction, stairways and stair platforms shall be constructed of reinforced concrete, iron or steel with treads and risers of concrete, iron or steel.

602.4 Walls.

- (a) In buildings of Types I and II construction, nonbearing walls required to be 1- or 2-hour fire-resistance construction shall be permitted to be fire-retardant-treated wood enclosed within noncombustible materials.
- (b) Fire-retardant-treated wood shall be permitted in nonbearing exterior walls where no fire rating is required.

SECTION 603 SPECIAL REQUIREMENTS— TYPE III CONSTRUCTION

603.1 Structural elements.

- (a) Structural elements of buildings of Type III construction shall be of heavy timber members (sawn or glued-laminated) or of fire-resistive construction as set forth in Table 6.2 when materials other than heavy timber are used.
- (b) Where horizontal separation of 20 feet or more is provided in buildings of Type III construction, wood columns, arches, beams, roof decking conforming to the requirements for heavy timber in Chapter 10 and EPCOT Standard 1010-9.801 may be used on the exterior of the building.

- (c) In buildings of Type III construction, bulkheads 30 inches below show windows may be of combustible material.

603.2 Partitions. In buildings of Type III construction, permanent partitions may be of solid wood construction formed by not less than two layers of matched boards of 1-inch nominal thickness or of 1-hour fire-resistive construction as set forth in Table 6.2.

603.3 Floors. In buildings of Type III construction, floors may be of heavy timber, masonry, wood, steel or iron, and shall be constructed as required in Chapters 7, 9 and 10.

603.4 Roofs. In buildings of Type III construction, roofs of heavy timber complying with the requirements of Section 1010 or roofs of 1-hour fire-resistive construction may be used.

603.5 Stairways. In buildings of Type III construction, stairways may be constructed with wood treads and risers of not less than 2-inch nominal thickness. Where built-on, laminated or plank inclines are required for floors, stairways may be 1-inch nominal thickness or may be constructed as required for buildings of Type I or II construction.

SECTION 604 SPECIAL REQUIREMENTS— TYPE IV CONSTRUCTION

604.1 Structural elements. In buildings of Type IV construction housing a Group A and (or) E occupancy, approved fire-retardant-treated wood may be used as an alternative to noncombustible roof construction. Fire protection of structural members may be omitted in such buildings where such structural members support a roof only and there is 20 feet or more clear height above the floor or balcony. In such buildings, structural members of heavy timber sizes may be used as alternatives to unprotected roof members. Approved exterior fire-retardant-treated wood studs may be used in exterior nonbearing walls when horizontally separated from the noncombustible structure by at least 5 feet.

604.2 Walls. In buildings of Type IV construction, nonbearing walls required to be 1- or 2-hour fire-resistance construction shall be noncombustible or fire-retardant-treated wood enclosed within noncombustible materials.

SECTION 605 SPECIAL REQUIREMENTS— TYPE V CONSTRUCTION

605.1 Structural elements. The structural elements of buildings of Type V construction shall be approved materials complying with the applicable provisions of Chapters 7 and 10, and the requirements of this Chapter.

605.2 Floors. In buildings having floors immediately above usable space in basements, the area above heating equipment shall have 1-hour fire protection, except where an automatic sprinkler system is installed.

**SECTION 606
SPECIAL REQUIREMENTS—
TYPE VI CONSTRUCTION**

606.1 Structural elements. The structural elements of buildings of Type VI construction may be any material permitted by this Code.

606.2 Enclosure of vertical openings. In buildings of Type VI construction, chutes and dumbwaiter shafts with cross-sectional areas of not more than 9 square feet may be lined with approved fire-resistive materials covered with not less than 26-gauge metal with all joints locklapped.

TABLE 6.2
FIRE PROTECTION REQUIREMENT FOR THE TYPES OF CONSTRUCTION^a

	TYPE I		TYPE II		TYPE III HT		TYPE IV				TYPE V				TYPE VI			
	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Protected	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Protected	Fire-Resistive Time Period (hr)	Opening Permitted %Wall	Fire-Resistive Time Period (hr)	Opening Permitted %Wall
STRUCTURAL MEMBER OR ELEMENT PROTECTED	3 NC	0	2 NC	0	2 NC	0	1 NC	0	2 NC	2 NC	0	1 NC	1 NC	2 NC	1	0	1	10
	3 NC	10	2 NC	10	2 NC	10	1 NC	10	2 NC	2 NC	10	1 NC	10	2 NC	1	10	0	N.L.
	2 NC	20	1 NC	20	1 NC	20	1 NC	20	1 NC	1 NC	20	1 NC	20	1 NC	1	20	0	N.L.
	2 NC	30	1 NC	30	1 NC	30	1 NC	30	1 NC	1 NC	30	1 NC	30	1 NC	1	30	0	N.L.
	1 NC	40	1 NC	40	1 NC	40	1 NC	40	1 NC	1 NC	40	1 NC	40	1 NC	1	40	0	N.L.
	1 NC	50	1 NC	50	1 NC	50	1 NC	50	1 NC	1 NC	50	1 NC	50	1 NC	1	50	0	N.L.
Exterior nonbearing walls with approved horizontal separation ^b	2 NC	0	1 NC	0	1	0	1 NC	0	1 NC	1 NC	0	1 NC	1 NC	1 NC	1	10	1	10
	1 NC	10	1 NC	10	1	10	1 NC	10	1 NC	1 NC	10	1 NC	10	1 NC	0	N.L.	0	N.L.
	1 NC	20	1 NC	20	1	20	1 NC	20	1 NC	1 NC	20	1 NC	20	1 NC	0	N.L.	0	N.L.
	1 NC	30	1 NC	30	1	30	1 NC	30	1 NC	1 NC	30	1 NC	30	1 NC	0	N.L.	0	N.L.
	NC	N.L.	NC	N.L.	NC	N.L.	NC	N.L.	NC	NC	N.L.	NC	N.L.	NC	0	N.L.	0	N.L.
	NC	N.L.	NC	N.L.	NC	N.L.	NC	N.L.	NC	NC	N.L.	NC	N.L.	NC	0	N.L.	0	N.L.
For inner court walls see Subsection 701.4 ^b																		
Penthouse walls ^d	NC		NC		NC		NC		NC	NC		NC		NC				
Partitions Interior bearing Interior nonbearing ^e	2 NC 1 NC		1 NC 1 NC		1 or HT 1 or HT		1 NC NC		1 NC 1 NC	Note e Note e		Note e Note e		Note e Note e	1 ^e		Note e	
Vertical openings ^{m, o}	1 NC		1 NC		1		1 NC		1 NC	1		1		1	1			

(continued)

TABLE 6.2—continued
FIRE PROTECTION REQUIREMENTS FOR THE TYPES OF CONSTRUCTION^a

STRUCTURAL MEMBER OR ELEMENT PROTECTED	TYPE I		TYPE II		TYPE III HT		TYPE IV				TYPE V				TYPE VI			
	Fire-Resistive Construction NC	Opening Permitted %/wall	Fire-Resistive Construction NC	Opening Permitted %/wall	Fire-Resistive Construction NC	Opening Permitted %/wall	Protected	Fire-Resistive Construction NC	Opening Permitted %/wall	Protected	Fire-Resistive Construction NC	Opening Permitted %/wall	Protected	Fire-Resistive Construction NC	Opening Permitted %/wall	Protected	Fire-Resistive Construction NC	Opening Permitted %/wall
Columns supporting masonry or bearing walls	3 NC		2 NC		1 ^{f, r} 1 or 6×8 ^g		1 NC ^f	1 NC		1 ^f	Note f		1 ^f	Note f			Note f	
Columns supporting Roofs only	1 NC		1 NC		1 or 6×8 ^g		1 NC	1 NC		1			1					
Other columns	2 NC		1 NC		1 or 8×8 ^g		1 NC	1 NC		1			1					
Trusses, girders, beams—Supporting masonry or bearing walls, columns, girders and beams	3 NC		2 NC ⁱ		1 NC ^{h, r} 1 or 4×6 ^g		1 NC ^h 1 NC	1 NC		1 ^h 1			Note h 1					
Supporting roofs	1 NC ⁱ		1 NC ⁱ		1 or 6×10 ^g		1 NC	1 NC		1	Note i							
Supporting floors	2 NC		1 NC				1 NC	1 NC										
Arches	2 NC		1 NC		1 ^g		1 NC	1 NC		1			1					
Floor ceiling assembly ⁿ	2 NC		1 NC		Note k		1 NC	1 NC		1	Note j		1					
Roof ceiling assembly ⁿ	1 NC ⁱ		1 NC ⁱ		Notes g and k		1	1		1			1					
20' or more above floor ^d	1 NC ⁱ		NC ⁱ				NC	NC		NC			NC			1		

HT – Heavy timber construction (for construction requirements, see Chapter 10 and EPCOT Standards 1010-1 and 1010-9).

NC – Construction required to be noncombustible.

N.L. – Not limited in openings permitted.

a. See Section 701 for requirements for protection of openings because of location on property.

b. See Subsection 707.5.

c. See Subsection 604.1.

d. See Subsection 706.1.

e. See Subsection 709.1.

f. See Subsection 702.3.

g. See Subsection 603.1(b).

h. See Subsection 702.2(b).

i. See Subsection 602.2.

j. See Subsection 605.2.

k. See Section 1010, and EPCOT Standards 1010-1 and 1010-9.

l. See Subsection 707.2 and Appendix L.

m. See EPCOT Standard 5-1 for elevator shaft protection.

n. See Chapter 9 for design load requirements.

o. See Table 7.2.

p. See Section 708.

q. See Subsection 506.3.

r. See Subsection 1010.2.

CHAPTER 7

GENERAL CONSTRUCTION REQUIREMENTS FOR FIRE SAFETY

SECTION 701 GENERAL REQUIREMENTS

701.1 General requirements.

- (a) Buildings shall adjoin or have access to a public space, yard or street on at least one side.
- (b) Required yards shall be maintained permanently.
- (c) The centerline of an adjoining street or alley shall be considered an adjacent property line for purposes of this Subsection.
- (d) Eaves over windows shall be not less than 30 inches from the side and rear property lines. For fire protection of eaves, see Subsection 707.6.

701.2 Fire resistance of exterior walls.

- (a) Exterior walls shall have the fire resistance and opening protection set forth in Table 6.2 in relation to the types of construction and distances to property lines, and shall comply with the requirements of Appendix B for location within the fire limits.
- (b) Construction and fire resistance of malls and covered walkways shall comply with the requirements of Appendix I.
- (c) Distances between buildings and property lines shall be measured at right angles from the property line. The provisions of this Section shall not apply to exterior walls constructed at right angles to the property line.

701.3 Projections. Projections from the exterior wall shall not extend beyond the following points:

- (a) A point one-third the distance to the property line from an exterior wall, or
- (b) A point one-third the distance from an assumed vertical plane located where fire-resistive protection of openings is first required because of location on property, whichever is the least restrictive.

701.4 Exterior wall openings.

- (a) Openings in exterior walls shall be limited as provided in Table 6.2 and shall be protected by a self-closing, an automatic-closing or fixed opening protective with a rating in accordance with Subsection 704.5 when less than 20 feet from an adjacent property line or from the centerline of the street or public space.

Exceptions:

- 1. In buildings of Type VI construction, openings not on a street front that are within 10 feet of an adjacent property line shall be protected as required in Paragraph (a).
- 2. Openings in walls of buildings housing Group R-3 occupancies shall not be required to be

protected, except when within 5 feet of an adjacent property line.

- (b) To determine the required wall and opening protection, buildings on the same property with inner court walls shall be assumed to have a property line between them.
- (c) When a new building is to be erected on the same property with an existing building, the assumed property line from the existing building shall be the distance to the property line for each type of construction, as set forth in Table 6.2.

Exceptions:

- 1. Two or more buildings on the same property may be considered parts of one building when the aggregate area of the building is within limits specified in Section 712 for a single building of the same occupancy and type of construction.
- 2. When the building so considered houses mixed occupancies or is of different types of construction, the area shall be as permitted for the most restrictive occupancy or type of construction. Tenant separation shall be provided as required by Subsection 508.3(c) for Group B, Division 1 and 2 occupancies.

701.5 Definitions:

F RATING. The time period that the through-penetration fire-stop system limits the spread of fire through the penetration when tested in accordance with ASTM E814 or UL 1479.

L RATING. The amount of air leakage (cubic feet per minute) through a penetration.

T RATING. The time period that the penetration fire-stop system, including the penetrating item, limits the maximum temperature rise to 325°F above its initial temperature through the penetration on the nonfire side when tested in accordance with ASTM E814 or UL 1479.

SECTION 702 STRUCTURAL ELEMENTS

702.1 Structural elements defined. The structural elements, as referred to herein, shall be considered to be the columns and girders, beams, trusses, joists, braced frames, moment-resistant frames, vertical- and lateral-resisting elements, and other framing members that are designed to carry any portion of the dead or live load and lateral forces, and that are essential to the stability of the building or structure.

702.2 Fire-resistive protection required.

- (a) Fire-resistive protection shall be provided for structural elements as set forth in Chapter 6 and EPCOT Standard 6-1. Thickness of the fire protection shall be the net thickness of the material.
- (b) Trusses, girders and beams supporting all bearing walls, columns, girders and trusses shall have the same fire-resistive rating as the wall, column, girder and truss supported.
- (c) The degree of fire resistance required for external structural members, defined as columns, trusses, girders and beams located beyond the perimeter of the building floor area, may be calculated by using analytical methods in accordance with the provisions set forth in Appendix L.

702.3 Fire protection of masonry.

- (a) Columns supporting masonry walls shall have the fire-resistive rating of the wall supported.
- (b) Where required in unit masonry construction, metal ties shall be embedded in the transverse joints. Such ties shall comply with EPCOT Standard 1006-2 or shall be equivalent to ties required therein.

702.4 Fire protection of steel columns. Cast-in-place concrete used for protecting steel columns shall be reinforced at the edges with wire ties of not less than 0.18 inch diameter wound spirally around the columns on a pitch of not more than 8 inches.

702.5 Attached metal members. The edges of lugs, brackets, rivets and bolt heads attached to structural elements may extend to within 1 inch of the surface of the fire-protective covering.

702.6 Reinforcing. Thickness of fire protection on concrete and masonry members shall be measured to the outside of the reinforcement, except that stirrups and spiral ties may project not more than 1/2 inch into the fire protection.

702.7 Bonded prestressed concrete tendons. Single- or multiple-bonded tendons in prestressed concrete beams, girders and solid slabs shall be fire protected as required in EPCOT Standard 6-1. Unbonded tendons may be accepted when substantiated by test, with the required thickness of fire protection at all locations.

702.8 Embedment of pipes. Conduits and pipes shall not be embedded within the required fire protection, except as approved by the Building Official.

702.9 Column jacketing. Fire-resistive covering of columns, where exposed to injury by moving vehicles, by handling of merchandise or by other means, shall be protected by a method approved by the Building Official.

SECTION 703 FIRE PROTECTION OF VERTICAL OPENINGS

703.1 Enclosure of vertical openings. When enclosure of vertical openings is required, the enclosure shall be constructed in accordance with the following provisions:

- (a) **Elevator enclosures.** See EPCOT Standard 5-1.
- (b) **Escalators.** See EPCOT Standard 5-1.

(c) Other vertical openings.

- 1. Shafts, ducts, chutes and other vertical openings not regulated in Paragraphs (a) and (b), shall be enclosed throughout their length with construction of not less than specified in Table 7.2 when penetrating two or more floors. A shaft that does not extend through the roof shall have its top enclosed with construction having a fire rating at least equal to that of the enclosing walls.
- 2. Openings into shaft enclosures shall be limited to those necessary for the purpose of the shaft and shall be protected in accordance with the requirements of Section 704.

(d) **Air ducts.** Air ducts passing through two or more floors shall be enclosed in a shaft constructed, as required, for other vertical openings in Paragraph (c). Dampers shall conform to the requirements of the *EPCOT Mechanical Code* and EPCOT Standard 7-1.

SECTION 704 REQUIREMENTS FOR FIRE-RESISTIVE MATERIALS AND SYSTEMS

704.1 Criteria.

- (a) Fire-resistive materials and assemblies of materials shall meet the fire-resistive requirements of this Chapter and EPCOT Standard 6-1. Fire-resistive materials, assemblies and systems used shall be limited to those permitted in this Code, unless accepted under the procedure set forth in Subsection 601.3, and shall conform to the EPCOT Standards cited in this Subsection and listed in Appendix A, and to the regulations of materials, assemblies of materials and systems specified in Chapter 10 and this Chapter.
- (b) The construction materials and details for fire-resistive assemblies and systems described shall comply with all other provisions of this Code, except as modified herein.

704.2 Fire-resistive protection of openings.

- (a) Where required, opening protectives shall comply with the requirements of EPCOT Standards 7-2 and 7-3.

Exception: Fire-resistance-rated glazing tested as part of a fire-resistance-rated wall assembly in accordance with ASTM E119 or UL 263 and labeled in accordance with Subsection 703.5 shall be permitted where used as a wall or floor/ceiling assembly. Fire-resistance-rated glazing shall be permitted in fire doors and fire window assemblies where tested and installed in accordance with their listings and where in compliance with the requirements of this Subsection.

- (b) **General.** Fire dampers shall comply with the requirements of UL 555 and shall bear the label of an approved testing agency. Fire dampers shall be classified and identified for use in either:

- 1. Static systems that are automatically shut down in the event of fire.
- 2. Dynamic systems that are operating in the event of fire.

(c) **Locations.** Fire dampers shall be installed in accordance with the manufacturer's installation instructions in the following locations:

1. Ducts penetrating walls or partitions having a fire-resistance rating of 1 or more hours.
2. Ducts penetrating shaft walls having a fire-resistance rating of 1 or more hours.
3. Ducts penetrating only one floor of a building requiring the protection of vertical openings when the duct is not protected by a shaft enclosure as described.
4. Wall registers penetrating fire-rated walls having a fire-resistance rating of 1 or more hours.

(d) **Exceptions.** Fire dampers are not required under the following conditions:

1. In openings in floors of buildings that do not require protected floor openings.
2. Where branch ducts connect to return risers in which the airflow is upward and subducts, at least 22 inches long, are carried up inside the riser at each inlet.
3. In duct systems of any duct material or combinations thereof allowed by Chapter 6 of the *EPCOT Mechanical Code* penetrating 1-hour walls or partitions, where the duct penetrating the rated wall or partition meets the following minimum requirements:
 - (a) The duct shall not exceed 100 square inches,
 - (b) The duct shall be of 0.0217 inch minimum steel,
 - (c) The duct shall continue with no duct openings for not less than 5 feet from the rated wall, and
 - (d) The duct shall be installed above a ceiling.

704.3 Opening protectives.

- (a) An opening protective is the assembly of a fire door, fire window or fire damper, including the required hardware, anchorage, frames and sills. An opening protective is termed automatic closing when it may remain in an open position and close automatically when subjected to either an increase in temperature or the products of combustion other than heat.
- (b) An opening protective is termed self-closing when it is kept in a normally closed position and is equipped with an approved device to ensure closing and latching.
- (c) Unless otherwise specified, the fire detection device and closer shall meet the following conditions:
 1. The closing device shall be rated at a maximum temperature of 165°F.
 2. When products of combustion other than heat are detected by and activate the closing device, it shall be set to operate before smoke reduces intensity of a 1-foot beam of light by 4 percent or any other detector that will react as quickly.

3. Detection devices activating the closer shall conform to EPCOT Standard 7-4.

(d) Automatic-closing opening protectives for fire doors and fire shutters installed in the following locations shall be automatic closing by the operation of an approved smoke detector installed in accordance with the requirements of NFPA 72 or by loss of power to the smoke detector or hold-open device:

1. Fire doors and fire shutters in walls used to protect the path of egress as identified by Subsection 704.10.
2. Fire doors and fire shutters in walls used to provide occupancy separation as required by Section 502.
3. Fire doors and fire shutters in fire division walls as allowed by Section 708.

Fire doors and fire shutters that are automatic closing by smoke detection shall not have more than a 10-second delay before the door starts to close after the smoke detector is actuated.

704.4 Protection of openings in interior walls. Openings in walls and partitions, except in one- and two-family dwellings, shall be protected in accordance with Table 7.2.

704.5 Approved types of fire windows, doors and shutters.

- (a) Wall openings required to be fire protected by Table 7.2 shall be protected by approved listed and labeled fire doors, windows and shutters, and their accompanying hardware, including all frames, closing devices, anchorage and sills, in accordance with the requirements of NFPA 80, except as otherwise specified in this Code.
- (b) Openings are classified in accordance with the character and location of the wall in which they are situated. Fire protection ratings for products intended to comply with this Section shall be as determined and reported by a nationally recognized testing agency in accordance with ASTM E152 or ASTM E163. All such products shall bear an approved label. In each of the classes in Paragraph (c), the minimum fire protection ratings are shown.

Exception: Doors located in common walls separating guest rooms in Group R-1 hotels and motels may be installed without automatic- or self-closing devices.

- (c) Fire doors are classified as 3-hour (A), 1½-hour (B), 1-hour (B), ¾-hour (C), 1½-hour (D), ¾-hour (E) or 20 minutes. The letter designation indicates the classification of opening in a wall or partition assembly for which a door is considered suitable and the relative importance of the door in preventing the spread of fire. These designations are described as follows:

1. Class A—openings in walls that divide a single building into fire areas or fire walls separating buildings.
2. Class B—openings in enclosures of vertical communications through buildings. They are also suitable for certain other openings in walls or partitions.

3. Class C—openings in walls or partitions between rooms and corridors or hallways, except as provided in Paragraph (d) for 20-minute doors.
 4. Classes D and E—openings in exterior walls subject to severe and moderate fire exposure from outside of the building, respectively.
- (d) In corridor walls and smoke barriers, all door openings shall be protected with a tight-fitting smoke and draft assembly (including door frame and hardware), tested in accordance with UL 1784. These doors shall be equipped with approved self-closing or automatic-closing devices. When approved by the Building Official, any door required to have a level of fire resistance that is permitted to be automatic closing by smoke detection or that is self-closing, may not have a delay in closing or reclosing of more than 10 seconds. Door assemblies shall be identified in accordance with their listing. These doors shall not have louvers.

Exception: Doors from classrooms in Group E occupancies, opening directly into a 1-hour fire-rated corridor, may be installed without self-closing devices.

- (e) The size of fire doors shall not exceed that specified in EPCOT Standard 7-6, except as may be modified by Subsection 804.4.
- (f) For 1½-hour (B) and 1-hour (B) doors used in stairway enclosures, the average temperature developed on the unexposed side shall not exceed 450°F at the end of 30 minutes of standard fire test exposure.
- (g) Fire doors shall be equipped with an approved closer.
- (h) Motor-operated overhead doors shall conform to the provisions of Subsection 704.10.

704.6 Hardware.

- (a) Every opening protective required to have a 3-hour fire-resistive rating shall be of fixed or automatic-closing types as specified in Subsection 704.3. Every opening protective required to have a 1½-hour, 1-hour or ¾-hour fire-resistive rating shall be an automatic-closing, fixed or self-closing type as required in Subsection 704.3.

Exceptions:

1. Dual-purpose fire exit doors shall have closing devices as required in Chapter 8.
2. Heat-activated devices used in automatic-opening protectives providing 3-hour fire protection shall be installed, one on top of each side of the wall opening and one on each side of the wall at ceiling height when the ceiling is more than 3 feet above the opening.
3. Opening protectives required to have 1½-hour, 1-hour or ¾-hour fire protection rating that are not classified as exit doors, may be activated as permitted in Exception 2, or by a detector or fusible link incorporated in the closing device.

- (b) Devices detecting products of combustion shall meet the approval of the Building Official for installation and location, and shall be subject to such periodic tests as may be required.
- (c) For exit doors and opening protectives that open onto interior exitways, see Chapter 8.

704.7 Glazed openings in fire doors. One-quarter-inch-thick wired glass, labeled for fire protection purposes, may be used in approved opening protectives with the maximum sizes shown in Table 7.1. Other glazing materials, which have been tested and labeled to indicate the type of opening to be protected for fire protection purposes, may be used in approved opening protectives in accordance with their listing with the maximum sizes tested. For requirements for safety glazing, see Section 1005.

TABLE 7.1
LIMITING SIZE OF WIRE GLASS PANELS^{a, b, c}

RATING, OPENING	MAX. AREA (square inches)	MAX. HEIGHT (inches)	MAX. WIDTH (inches)
3-hour, Class A door	0	0	0
1- & 1½-hour, Class B door	100	33	12
¾-hour, Class C door	1,296	54	54
1½-hour, Class D door	0	0	0
¾-hour, Class E door	1,296	54	54

- a. The glass shall be well embedded in putty and all exposed joints between the metal and glass shall be struck and pointed.
- b. Devices used to view through fire doors rated at 1½ hours or less shall be labeled.
- c. Wired glass in 20-minute doors shall be limited to the amount of glass tested in a door.

704.8 Glazed openings in fire windows. Three-fourths-hour fire-resistive-rated windows may have an area not more than 84 square feet with neither width nor height exceeding 12 feet. Fire windows shall be either fixed or automatic closing.

704.8.1 Fire-protection-rated glazing. Glazing in fire window assemblies shall be fire-protection-rated in accordance with this Section and Table 7.2. Glazing in fire door assemblies shall comply with Subsection 704.7. Fire-protection-rated glazing shall be tested in accordance with, and shall meet the acceptance criteria of, NFPA 257 or UL 9. Fire-protection-rated glazing shall also comply with NFPA 80. Openings in nonfire-resistance-rated exterior wall assemblies that require protection in accordance with Subsection 707.3, shall have a fire-protection rating of not less than ¾ hour.

Exception: Wired glass in accordance with Subsection 704.7.

TABLE 7.2
**MINIMUM FIRE RESISTANCE OF WALLS,
PARTITIONS AND OPENING PROTECTIVES**

COMPONENT	WALLS AND PARTITIONS (hours)	OPENING PROTECTIVES (hours)
Elevator hoistways	See Standard 5-1	

(continued)

TABLE 7.2—continued
MINIMUM FIRE RESISTANCE OF WALLS,
PARTITIONS AND OPENING PROTECTIVES

COMPONENT	WALLS AND PARTITIONS (hours)	OPENING PROTECTIVES (hours)
Vertical shafts	2 (See Sections 703 and 809)	1½B
Fire division walls	3 (See Section 708)	3A (See Subsection 708.2)
Occupancy separations	See Section 502	
Tenant separations Walls within tenant spaces	1 (See Subsection 502.5) See Note a	¾C
Exit enclosures	See Section 809	See Subsection 809.3
Exterior stairways	See Subsections 806.10 and 806.12(b)	
Smoke-protected enclosures	See Section 810	
Horizontal exits	2 (See Section 808)	1½B
Corridors	1 (See Subsection 805.7)	20 minutes
Refuse chute access room	1	¾C
Hazardous use separations	See Section 511	
High-rise buildings	See Section 718	
Bathrooms and restrooms	See Note b	

- a. Partitions dividing off stores, offices or similar places occupied by one tenant only that do not establish a corridor serving an occupant load of 30 or more persons may be movable, partial or full height, temporary or permanent and may be constructed of any material approved by this Code provided that:
1. They do not block required exits (without providing alternative conforming exits) and they do not establish an exit corridor.
 2. Their location is restricted by means of permanent tracks, guides or other approved methods.
 3. Flammability shall be limited to materials having a flame spread classification as set forth in Table 7.4 for rooms or areas.
- b. Fire-rated bathroom/restroom doors are not required when opening onto fire-rated halls, corridors or exit access provided:
1. No other rooms open off the bathroom/restroom;
 2. No gas or electric appliances are located in the bathroom/restroom;
 3. The walls, partitions, floor and ceiling of the bathroom/restroom have a fire rating at least equal to the rating of the hall, corridor or exit access; and
 4. The bathroom/restroom is not used for any other purpose than it is designed for.

704.9 Tin-clad doors. When constructed as specified in EPCOT Standard 7-5, tin-clad doors installed on each side of openings requiring protection shall be considered equal to a 3-hour opening protective, provided that each door bears the label of an approved testing agency, showing the classification of the door.

704.10 Power-assisted overhead doors. When installed, power-operated rolling overhead doors shall comply with all of the following:

- (a) Close under power utilizing a minimum closure rate of 6 inches per second and a maximum closure rate of 24 inches per second.

- (b) Be provided with edge protection for the purpose of obstruction cycling. The edge protection shall allow the door to cycle until the obstruction clears or for a maximum of three cycles. After the obstruction is cleared or the maximum three cycles occur, the door shall close or come to rest on the obstruction.
- (c) Include an audible and visual signal to alert occupants when the door is closing.
- (d) Close upon activation of any building alarm notification system, including fire water flow, or initiate the closing operation within 10 seconds of transfer to emergency power.
- (e) Be provided with a power supply complying with Article 701 of the *National Electrical Code*® (NEC®).

704.11 Installation of opening protectives. Opening protectives shall be installed as required in EPCOT Standards 7-5 and 7-6.

SECTION 705 FIRE PROTECTION OF FLOORS, ROOFS AND CEILINGS

705.1 General requirements. Floors and roofs shall be designed and constructed in accordance with Chapters 9 and 10, and this Section.

705.2 Fire protection of floors.

- (a) Floors shall be fire protected as required for the type of construction in Sections 602 through 606, and Table 6.2. (See Subsection 602.1 for firestopping.)
- (b) Combustible insulating boards may be used under finish flooring.
- (c) Exterior loading platforms may be of noncombustible construction of heavy timber, with wood floors not less than 2 inches nominal thickness. Such wood construction shall not extend through exterior walls.

705.3 Fire protection of roofs.

- (a) Roofs shall be fire protected as required for the type of construction in Sections 602 through 606, and Table 6.2, and in accordance with the requirements of EPCOT Standard 7-7.
- (b) Roof covering shall be Class A or B fire retardant as classified in EPCOT Standard 7-7, except that roofs of Type VI buildings housing Group R or S occupancies may be Class C roofing.
- (c) Insulation shall be permitted on all buildings, provided that an approved roof covering is applied over the insulation.
- (d) Fire-resistive roofs may have openings as permitted for floors in Subsection 705.2 and may have openings as permitted by this Code. (See Section 706 for construction of skylights.)
- (e) Where metal roofing or siding is installed over a non-conductive base, provisions shall be made for bonding or grounding such metal roofing or siding in accordance with the *EPCOT Electrical Code*.

705.4 Attic access. An attic access opening shall be provided in the ceiling of the top floor of all buildings having attics.

- (a) The opening shall be located in a corridor or hallway in buildings of three or more stories and shall be readily accessible in buildings of any height.
- (b) The opening shall be not less than 22 inches by 30 inches in area.
- (c) Attics with a maximum vertical clear height of less than 30 inches need not be provided with access openings.

705.5 Draftstops.

- (a) Any concealed combustible space in which building materials are exposed, which has a flame spread index greater than Class A, shall be draftstopped as follows:
 - 1. Every unoccupied attic space shall be subdivided by draftstops into areas not to exceed 3,000 square feet.
 - 2. Any concealed space between the ceiling and the floor or roof above shall be draftstopped for the full depth of the space along the line of support for the floor or roof structural members and, if necessary, at other locations to form areas not to exceed 1,000 square feet for any space between the ceiling and floor, and 3,000 square feet for any space between the ceiling and roof.

Exception: If concealed space is fully sprinklered, the draftstop area may be increased to 9,000 square feet.

- (b) Draftstopping materials shall be not less than 1/2-inch gypsum board, 15/32-inch wood structural panels or other approved materials adequately supported.
- (c) The integrity of all draftstops shall be maintained.

705.6 Ventilation. Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of the roof rafters shall have cross ventilation for each separate space by means of protected ventilating openings. The net free ventilating area shall be not less than 1/150 of the ceiling area of the space ventilated. The ratio may be reduced to 1/300 when at least 50 percent of the required ventilating area is provided by ventilators located in the upper part of the space to be ventilated. Ventilators shall be placed at least 3 feet above eave or cornice vents and the remaining 50 percent of the required ventilation shall be provided by eave and cornice vents.

705.7 Duct openings. All ceiling duct openings in fire-resistive construction shall be protected by approved fire dampers in accordance with the requirements of EPCOT Standard 7-1 and the *EPCOT Mechanical Code*.

Exception: Openings may be installed where such openings and protectives have been tested in accordance with the requirements of Subsection 704.2.

705.8 Floor-ceiling and roof-ceiling assemblies.

- (a) Construction systems composed of fire-resistive floor and ceiling or roof and ceiling assemblies shall have the fire-resistance rating set forth in Table 6.2 and

EPCOT Standard 6-1. (For provisions covering design of roof and floor construction, see Chapter 9.)

- (b) Where a ceiling forms a protective membrane for fire-resistive assemblies, the construction and supporting horizontal structural members need not be fire protected individually, except where such members support directly applied loads from one floor or roof. The fire resistance shall be in accordance with the requirements of Table 6.2.
- (c) Ceilings shall form continuous fire-resistive membranes, but may have openings as permitted for floors in Subsection 707.10 where the ceiling openings aggregate is not more than 100 square inches for any 100 square feet of ceiling.
- (d) Where 1-hour fire-resistive construction is required for floor or ceiling assemblies, the fire protection may be omitted from the underside of the floor in the crawl space area at grade and from the attic area of the ceiling where the roof forms the upper surface of the attic.

705.9 Plastic light diffusers in ceilings.

- (a) For the purpose of this Section, a light-diffusing ceiling shall be defined as any light-diffusing or light-transmitting ceiling consisting of transparent, translucent, louvered, eggcrated, mesh or similar materials suspended from a ceiling or structural framework by means of hangers and may include the supporting grid on which the material rests.
- (b) Where walls and ceilings are required to be fire resistive or of noncombustible construction, and walls are set out or ceilings are dropped more than 1 3/4 inches, Class I materials shall be used, except where finish materials are protected on both sides by an automatic sprinkler system.

Exception: Ceiling light diffusers of approved plastics shall not be required to conform to the requirements of Paragraph (b) when the installation meets the following requirements:

- 1. The ceiling light diffusers, as installed, will fall from their mountings at an ambient temperature of at least 200°F below the ignition temperature of the plastic material, measured in accordance with EPCOT Standard 1008-1, as shown in appropriate tests by a recognized testing laboratory.
- 2. The plastic light diffusers are mounted in the ceiling so that they will remain in place at an ambient room temperature of 175°F for a period of not less than 15 minutes.
- 3. Light-diffusing ceilings installed below sprinkler heads shall be installed so that they will not interfere with the effective operation of the automatic sprinkler system, and shall provide ready access to all valves and sprinkler heads of the system.
- 4. The maximum size of any single plastic light-transmitting panel shall not exceed 10 square feet.

705.10 Plastic light diffusers in electrical fixtures. Light-transmitting and light-diffusing panels made from approved plastic materials installed with approved electric lighting fixtures shall be exempt from the requirements of Section 709 and shall meet the following requirements:

- (a) The light diffusers shall meet the requirements of Subsection 705.9(b), Exceptions 1 and 2.
- (b) Unless the occupancy is protected by an approved automatic fire-extinguishing system, the area of approved plastic materials, when used in exitways, exit passages or corridors, or in Group A and D occupancies, shall not be more than 30 percent of the aggregate area of the ceiling in which they are installed.
- (c) The maximum area of a single plastic light diffuser shall not be more than 30 square feet.

SECTION 706 PENTHOUSES, ROOF STRUCTURES AND SKYLIGHTS

706.1 Penthouses and roof structures.

- (a) Penthouses or other projections above the roof in buildings or structures of Type I or II construction shall be not more than 28 feet high above the roof when used as an enclosure for tanks or for elevators that run to the roof and, in all other cases, shall extend not more than 12 feet above the roof.
- (b) Where penthouse walls are set back less than 5 feet from the exterior wall, they shall conform to the requirements for fire resistance of the exterior wall of the building.
- (c) The aggregate area of penthouses and other roof structures shall not be more than 33 $\frac{1}{3}$ percent of the area of the supporting roof.
- (d) No penthouse, bulkhead or similar projection above the roof shall be used for any purpose other than shelter of mechanical equipment or shelter of vertical shaft openings in the roof. Penthouses or bulkheads used for purposes other than permitted by this Subsection shall conform to the requirements of this Code for an additional story.
- (e) Roof structures shall be constructed with walls, floors and roof as required for the main part of the building and shall be fire protected as required in Table 6.2.
- (f) Roof signs shall be designed in accordance with Sections 903 and 904, and shall be constructed in accordance with the requirements of Appendix D.

706.2 Towers and spires.

- (a) Towers and spires, when enclosed, shall have exterior walls as required for the building upon which they are constructed. The framework of unenclosed towers extending more than 75 feet above grade shall be constructed of iron, steel or reinforced concrete. If the area of the tower or spire is more than 100 square feet in any horizontal cross section, its supporting frame shall extend directly to the ground or shall be supported by the structural frame of the building. The roof covering

of towers and spires shall be as required for the roof of the building.

- (b) Skeleton towers used as radio and television masts, located on the roof of a building or structure shall be constructed of noncombustible materials when more than 25 feet high and shall be supported on a noncombustible framework direct to the ground.

706.3 Sloped glazing.

- (a) **Scope.** Sloped glazing includes any installation of glass or other transparent, translucent or opaque glazing material installed at a slope of 15 degrees or more from the vertical plane. Glazing materials in skylights, roofs and sloped walls are included within this definition.
- (b) **Allowable glazing materials.** Sloped glazing shall be any of the following materials, subject to the limitations specified in Paragraph (d) and the exceptions specified in Paragraph (e):

1. For monolithic glazing systems, the glazing material of the single lite or layer shall be laminated glass with a minimum 30 mil polyvinyl butyral (or equivalent) interlayer, wired glass, approved plastic materials meeting the requirements of Section 1008, heat-strengthened glass or fully tempered glass.

2. For multiple-layer glazing systems, each lite or layer shall consist of any of the glazing materials specified in Paragraph 1.

- (c) See Subsection 706.4 for additional requirements for plastic skylights.

- (d) **Limitations.** Heat-strengthened glass and fully tempered glass when used in monolithic glazing systems, shall have screens installed below the glazing material, subject to the exceptions in Paragraph (e), to protect building occupants from falling glass should breakage occur. The screens shall be capable of supporting the weight of the glass, and shall be substantially supported below and installed within 4 inches of the glass. They shall be constructed of a noncombustible material not thinner than a 0.0808-inch (12 B & S ga) diameter with a mesh not larger than 1 inch by 1 inch. In a corrosive atmosphere, structurally equivalent noncorrosive screening materials shall be used. Heat-strengthened glass, fully tempered glass and wired glass, when used in multiple-layer glazing systems as the bottom glass layer over the walking surface, shall be equipped with screening meeting the requirements specified for monolithic glazing systems.

- (e) In monolithic and multiple-layer sloped glazing systems, the following exceptions apply:

1. Fully tempered glass may be installed without required protective screens when glazing between intervening floors at a slope of 30 degrees or less from the vertical plane if the highest point of the glass is 10 feet or less above the walking surface.

2. Any glazing material, including annealed glass, may be installed without required screens if the walking surface or any other accessible area below the glazing material is permanently protected from the risk of falling glass.
3. Any glazing material, including annealed glass, may be installed without screens in the sloped glazing systems of commercial or detached greenhouses used exclusively for growing plants and not accessible to the public provided the height of the greenhouse at the ridge does not exceed 20 feet above grade. Frames may be of wood construction in greenhouses located outside the fire district if the height of the sloped glazing does not exceed 20 feet above grade. In other cases, noncombustible frames shall be used.

(f) **Sloped glazing framing.** In other than Types III, V and VI construction, all sloped glazing and skylight frames shall be constructed of noncombustible materials. In foundries or buildings where acid fumes deleterious to metal are incidental to the use of the buildings, approved pressure-treated woods or other approved noncombustible materials shall be permitted for sash and frames. All sloped glazing and skylights shall be designed for the tributary roof loads in Section 903. All skylights set at an angle of less than 45 degrees from the horizontal plane shall be mounted at least 4 inches above the plane of the roof on a curb construction as required for the frame. Sloped glazing may be installed in the plane of the roof where the roof pitch is greater than 45 degrees from the horizontal.

706.4 Plastic skylights.

(a) **General.** Skylight assemblies may be glazed with approved plastic materials in accordance with the provisions of Subsection 706.4. (See Section 1008.)

Exception: These provisions need not be applied if the building on which the skylights are located is not more than one story in height, the building has an exterior separation from other buildings of at least 30 feet and the room or space sheltered by the roof is not classified in a group of high-hazard or institutional uses or as a mean of egress, or the plastic material meets the fire-resistance requirements of the roof.

(b) The approval of thermoplastic light-transmitting materials without a curb shall include the following considerations:

1. Expansion and contraction.
2. Durability.
3. Condensation removal.
4. Effects of sealants and roofing cements.

(c) **Mounting.** The glazing shall be mounted at least 4 inches above the plane of the roof on a curb constructed consistent with the requirements for the type of construction classification. Edges of plastic sky-

lights and domes shall be protected by metal or noncombustible material.

Exceptions:

1. Curb requirements for skylights may be omitted when used on roofs with a minimum slope of 3:12 in one- and two-family dwellings or on buildings with an unclassified roof covering.
 2. The metal or noncombustible edge material is not required where unclassified roof coverings are permitted.
- (d) Flat or corrugated plastic skylights shall slope at least 4:12. Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome, but not less than 3 inches.
- (e) **Maximum area of skylight unit.** Each skylight unit shall have a maximum area of 100 square feet within the curb.

Exception: The area of skylight units shall not be limited in buildings equipped with an automatic fire suppression system or if the skylight is serving as an approved fire venting system.

(f) **Aggregate area.** The aggregate area of skylights shall not exceed 33 $\frac{1}{3}$ percent when CC 1 materials are used, and 25 percent when CC 2 materials are used, of the floor area of the room or space sheltered by the roof in which they are installed.

Exception: The aggregate area of skylights may be increased 100 percent provided the skylight is serving as an approved fire venting system.

(g) **Separation.** Skylights shall be separated from each other by a distance of not less than 4 feet measured in a horizontal plane.

Exceptions:

1. The separation shall not be required provided the skylight is serving as an approved fire venting system.
 2. In one- and two-family dwellings or on buildings with an unclassified roof covering, skylights shall be separated from each other by a distance of not less than 16 inches measured in a horizontal plane.
- (h) **Location.** Where exterior wall openings are required to be fire-resistance rated, a skylight shall not be installed within 6 feet of such exterior wall.

SECTION 707 FIRE PROTECTION OF WALLS AND PROJECTIONS

707.1 Fire-resistive rating required. Bearing and nonbearing walls required to be fire protected by the provisions of this Code shall have the fire-resistive ratings established by criteria specified in EPCOT Standard 6-1. [See Subsection 705.2(c).]

707.2 Combustible members. Combustible members framed into a wall shall be end-protected by not less than one-half the thickness of protection required for the fire-resistive wall.

707.3 Exterior walls.

- (a) **Fire resistance.** Exterior walls shall have the fire resistance required in Table 6.2 for the type of construction and shall conform to the requirements of this Section and Section 701 for the protection for walls and openings in walls because of location on property.
- (b) **Exterior openings.** Exterior openings located vertically above one another in buildings over two stories high shall have not less than 3 feet vertical separation provided by an assembly of noncombustible material having a fire-resistive rating as required for the type of construction (see Table 6.2) between the top of one opening and the bottom of the next opening above; or the exterior openings shall be separated by such an assembly extending outwardly from the building wall a distance of not less than 30 inches, unless an automatic sprinkler system is installed throughout the building.
- (c) **Exterior wall panels of plastic.** Approved light-transmitting plastic materials, as defined in Chapter 10, may be used as wall panels or as components of wall panels in all types of buildings equipped with an automatic sprinkler system or in wall openings not required to be fire resistive or fire protected. Such installations shall comply with the following requirements:
 - 1. **Area.** The aggregate area of the wall surface in which the plastic panels are installed shall not exceed 30 percent of the wall area of each story.
 - 2. **Height.** In buildings more than one story, individual plastic panels shall be not more than 10 feet high.
 - 3. **Separation.** Single assemblies or runs of continuously mounted plastic wall panels up to 100 feet long shall be separated longitudinally by a section of noncombustible wall construction at least 4 feet long. Assemblies or runs of plastic wall panels shall be separated vertically by a section of noncombustible wall construction at least 4 feet long. Assemblies or runs of plastic wall panels shall be separated vertically by a section of noncombustible wall construction 4 feet high or 50 percent of the height of the highest panel in the next lower assembly or run.

Exception: Area limitation and separation requirements shall not be applicable to the use of approved plastic wall panels in Type VI unprotected construction.

- 4. **Continuous projections.** In buildings or structures having continuous architectural projections on each floor above the first floor, meeting the requirements of Subsection 707.6 and extending 30 inches or more from the surface of the walls in which plastic panels are installed, no vertical separation shall be required except that provided by the vertical thickness of the projection.

- 5. **Fire Department entry and venting.** Plastic panels installed in exterior walls shall be of materials easily removed by fire fighters to permit venting of a fire or entry of a building by fire fighters, or clearly marked access panels shall be provided in compliance with the provisions of Paragraph (f).

- (d) **Combinations.** Combinations of light-transmitting plastic glazing and plastic wall panels shall be subject to limitations as to height and area, and requirements for separation applicable to the class of plastics as specified for wall panel installations.
- (e) **Glazing.** Doors, sash and framed openings in exterior walls of all buildings and structures shall be glazed with glass or with approved plastics, and the installation shall be as specified for glass in Section 1005 and for plastics in Section 1008.
- (f) **Access panels in windowless walls.**

- 1. An access door or covered opening with suitable hardware and identifying marking shall be installed in the exterior wall on each floor above the main floor, with free access into the building.
- 2. Such access shall have a minimum net clear opening width dimension of 32 inches and a minimum net clear opening height dimension of 48 inches and with the bottom of the opening not more than 32 inches above the floor.
- 3. The exterior of the opening shall have distinctive markings for purpose of ease in locating panels.
- 4. Such access opening(s) shall open into a fire aisle within the building and no shelving, loose or fixed, no containers or equipment of any description, nor any loose merchandise shall be placed to block the aisleway.
- 5. Openings shall be so placed that there will be one opening in each 50 feet of exterior wall on each accessible side of the building. Buildings equipped with an automatic sprinkler system throughout shall have access panels as set forth in Paragraph 4 for each 200 feet of wall.

707.4 Lintels. Fire protection may be omitted from the bottom flange of lintels spanning not more than 6 feet; shelf angles or plates that are not part of the structural frame.

707.5 Parapet walls.

- (a) Parapet walls shall be provided on the exterior of all buildings except as follows:
 - 1. Walls not required to be of fire-resistive construction.
 - 2. In Types III, V and VI construction, exterior fire-retardant-treated wood may be used in lieu of required noncombustible material.
 - 3. Walls where unprotected openings are permitted.
 - 4. Where the roof sloped more than 4 inches in 12 inches from the back of the exterior wall of the building.

5. Where the exterior wall of the building is located 20 feet from the property line, or on an alley or public way 20 feet or more wide.

- (b) Parapets shall have the same degree of fire resistance as required for the wall upon which they are erected. Parapets shall extend not less than 26 inches above any part of the roof that is within 10 feet of the parapet wall.
- (c) All parapet walls shall have coping of approved materials.

707.6 Projections.

- (a) Projections from exterior walls of buildings shall comply with the requirements of Subsection 701.3 for location on property.
- (b) Cornices, architectural appendages, eave overhangs, marquees, awnings and other projections extending beyond the exterior wall shall be supported by the building and shall be constructed of materials where required for the type of construction (see Table 6.2). Exterior fire-retardant-treated wood may be used for cornices, architectural appendages, eave overhangs, marquees and similar projections.
- (c) Cornices, architectural appendages, eave overhangs, marquees and similar projections extending over public property shall be designed for live loads in accordance with Chapter 9 and shall be constructed as specified in Section 402.
- (d) Awnings shall be constructed as required in Chapter 4, Subsection 402.6.

707.7 Walls fronting on a public way. Regardless of fire-resistive requirements for exterior walls, wall components facing the public way may be constructed as follows:

- (a) Show-window frames, aprons and showcases located at grade level may be of combustible materials when the height of the construction is not more than 15 feet above grade.
- (b) Exterior-type wood veneer not less than $\frac{3}{4}$ -inch nominal thickness or exterior-type plywood not less than $\frac{3}{8}$ -inch nominal thickness may be applied to two-story buildings to a height of 15 feet. The wood shall be placed directly against noncombustible surfaces or furred out $1\frac{5}{8}$ inches maximum, with all concealed spaces firestopped in accordance with the requirements of Subsection 707.9. Where exterior fire-retardant-treated wood is used, the height may be increased to 35 feet.

707.8 Bays, porches and balconies.

- (a) Construction of walls and floors in bays and oriels shall conform to the type of construction and degree of fire resistance permitted for exterior walls and floors of buildings to which they are attached. The roof covering of a bay or oriel window shall conform to the requirements for roof covering of the building.
- (b) Exterior balconies attached to or supported by walls required to be of masonry shall have brackets or beams constructed of noncombustible material. Railings shall

be provided for balconies, landings or porches more than 36 inches above grade, and such railings shall be constructed as required in Subsections 503.11 and 902.2(h).

707.9 Firestops.

- (a) Firestopping shall be provided to cut off all vertical and horizontal concealed openings. Firestopping, when of wood, shall be not less than 2 inches thick and shall effectively fill all spaces for the entire width of depth of the framing or structural member. Firestopping shall be securely and tightly fitted into place. In the case of spaces between chimneys and wood framing, such spaces shall be solidly filled with mortar or loose noncombustible matter on noncombustible supports. Firestopping shall be installed in the following locations:
 1. In exterior and interior stud walls, at ceiling and floor levels.
 2. In combustible stud walls and partitions, including furred spaces, placed so that the maximum dimension of a concealed space is 8 feet.
 3. At all interconnections between concealed vertical and horizontal spaces, such as occur at soffits, drop ceilings, cove ceiling, etc.
 4. In concealed spaces between stair stringers at the top and bottom of the run.
 5. At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels with noncombustible materials.
 6. In concealed spaces created by an assembly of floor joists, firestopping shall be provided for the full depth of the joists at the ends and over the supports.
- (b) Except as provided in Subsection 707.9(a)4, firestopping shall consist of 2-inch nominal lumber, or two thicknesses of 1-inch nominal lumber with broken lap joints, or one thickness of $\frac{23}{32}$ -inch plywood with joints backed by $\frac{23}{32}$ -inch plywood or other approved materials.

707.10 Scope. The provisions of this Section shall govern the materials and methods of construction used to protect through penetrations and membrane penetrations of horizontal assemblies and fire-resistance-rated wall assemblies.

707.10.1 Ducts and air transfer openings. Penetrations of fire-resistance-rated walls by ducts that are not protected with dampers shall comply with Subsections 707.10.2 through 707.10.3.3. Penetrations of horizontal assemblies not protected with a shaft as permitted by Subsection 703.1, and not required to be protected with fire dampers by other sections of this Code, shall comply with Subsections 707.10.4 through 707.10.4.2.2. Ducts and air transfer openings that are protected with dampers shall comply with the requirements of UL 555.

707.10.2 Installation details. Where sleeves are used, they shall be securely fastened to the assembly penetrated. The space between the item contained in the sleeve and the

sleeve itself and any space between the sleeve and the assembly penetrated shall be protected in accordance with this Section. Insulation and coverings on or in the penetrating item shall not penetrate the assembly unless the specific material used has been tested as part of the assembly in accordance with this Section.

707.10.3 Fire-resistance-rated walls. Penetrations into or through fire walls, fire barriers, smoke barrier walls and fire partitions shall comply with Subsections 707.10.3.1 through 707.10.3.3. Penetrations in smoke barrier walls shall also comply with Subsection 707.10.5.

707.10.3.1 Through penetrations. Through penetrations of fire-resistance-rated walls shall comply with Subsection 707.10.3.1.1 or 707.10.3.1.2.

Exception: Where the penetrating items are steel, ferrous or copper pipes, tubes or conduits, the annular space between the penetrating item and the fire-resistance-rated wall is permitted to be protected as follows:

1. In concrete or masonry walls where the penetrating item is a maximum 6-inch nominal diameter and the area of the opening through the wall does not exceed 144 square inches, concrete, grout or mortar is permitted where it is installed the full thickness of the wall or the thickness required to maintain the fire-resistance rating; or
2. The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E119 (EPCOT Standard 6-1) or UL 263 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch of water at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.

707.10.3.1.1 Fire-resistance-rated assemblies. Penetrations shall be installed as tested in an approved fire-resistance-rated assembly.

707.10.3.1.2 Through-penetration firestop system. Through penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E814 (EPCOT Standard 7-24) or UL 1479, with a minimum positive pressure differential of 0.01 inch of water and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.

707.10.3.2 Membrane penetrations. Membrane penetrations shall comply with Subsection 707.10.3.1. Where walls or partitions are required to have a fire-resistance rating, recessed fixtures shall be installed such that the required fire-resistance will not be reduced.

Exceptions:

1. Membrane penetrations of maximum 2-hour fire-resistance-rated walls and partitions by steel electrical boxes that do not exceed 16 square inches in area, provided the aggregate

area of the openings through the membrane does not exceed 100 square inches in any 100 square feet of wall area. The annular space between the wall membrane and the box shall not exceed $\frac{1}{8}$ inch. Such boxes on opposite sides of the wall or partition shall be separated by one of the following:

- 1.1. By a horizontal distance of not less than 24 inches where the wall or partition is constructed with individual noncommunicating stud cavities;
 - 1.2. By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose-fill, rockwool or slag mineral wool insulation;
 - 1.3. By solid firestopping in accordance with Subsection 707.9;
 - 1.4. By protecting both outlet boxes with listed putty pads; or
 - 1.5. By other listed materials and methods.
2. Membrane penetrations by listed electrical boxes of any material, provided such boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing. The annular space between the wall membrane and the box shall not exceed $\frac{1}{8}$ inch unless listed otherwise. Such boxes on opposite sides of the wall or partition shall be separated by one of the following:
 - 2.1. By the horizontal distance specified in the listing of the electrical boxes;
 - 2.2. By solid firestopping in accordance with Subsection 707.9;
 - 2.3. By protecting both boxes with listed putty pads; or
 - 2.4. By other listed materials and methods.
 3. Membrane penetrations by electrical boxes of any size or type, which have been listed as part of a wall opening protective material system for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing.
 4. Membrane penetrations by boxes other than electrical boxes, provided such penetrating items and the annular space between the wall membrane and the box, are protected by an approved membrane penetration firestop system installed as tested in accordance with ASTM E814 (EPCOT Standard 7-24) or UL 1479, with a minimum positive pressure differential of 0.01 inch of water, and shall have an F

rating and T rating of not less than the required fire-resistance rating of the wall penetrated and be installed in accordance with their listing.

5. The annular space created by the penetration of an automatic sprinkler, provided it is covered by a metal escutcheon plate.

707.10.3.3 Dissimilar materials. Noncombustible penetrating items shall not connect to combustible items beyond the point of firestopping unless it can be demonstrated that the fire-resistance integrity of the wall is maintained.

707.10.4 Horizontal assemblies. Penetrations of a floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly not required to be enclosed in a shaft by Subsection 703.1 shall be protected in accordance with Subsections 707.10.4.1 through 707.10.4.2.2.

707.10.4.1 Fire-resistance-rated assemblies. Penetrations of the fire-resistance-rated floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall comply with Subsections 707.10.4.1.1 through 707.10.4.1.3. Penetrations in horizontal smoke barriers shall also comply with Subsection 707.10.5.

707.10.4.1.1 Through penetrations. Through penetrations of fire-resistance-rated horizontal assemblies shall comply with Subsection 707.10.4.1.1.1 or 707.10.4.1.1.2.

Exceptions:

1. Penetrations by steel, ferrous or copper conduits, pipes, tubes or vents or concrete or masonry items through a single fire-resistance-rated floor assembly where the annular space is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E119 (EPCOT Standard 6-1) or UL 263 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch of water at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated. Penetrating items with a maximum 6-inch nominal diameter shall not be limited to the penetration of a single fire-resistance-rated floor assembly, provided the aggregate area of the openings through the assembly does not exceed 144 square inches in any 100 square feet of floor area.
2. Penetrations in a single concrete floor by steel, ferrous or copper conduits, pipes, tubes or vents with a maximum 6-inch nominal diameter, provided the concrete, grout or mortar is installed the full thickness of the floor or the thickness required to maintain the fire-resistance rating. The penetrating items shall not be limited to the penetration of a single concrete floor, provided the area

of the opening through each floor does not exceed 144 square inches.

3. Penetrations by listed electrical boxes of any material, provided such boxes have been tested for use in fire-resistance-rated assemblies and installed in accordance with the instructions included in the listing.

707.10.4.1.1.1 Installation. Through penetrations shall be installed as tested in the approved fire-resistance-rated assembly.

707.10.4.1.1.2 Through-penetration firestop system. Through penetrations shall be protected by an approved through-penetration firestop system installed and tested in accordance with ASTM E814 (EPCOT Standard 7-24) or UL 1479, with a minimum positive pressure differential of 0.01 inch of water. The system shall have an F rating and T rating of not less than 1 hour but not less than the required rating of the floor penetrated.

Exceptions:

1. Floor penetrations contained and located within the cavity of a wall above the floor or below the floor do not require a T rating.
2. Floor penetrations by floor drains, tub drains or shower drains contained and located within the concealed space of a horizontal assembly do not require a T rating.

707.10.4.1.2 Membrane penetrations. Penetrations of membranes that are part of a horizontal assembly shall comply with Subsection 707.10.4.1.1.1 or 707.4.1.1.2. Where floor/ceiling assemblies are required to have a fire-resistance rating, recessed fixtures shall be installed such that the required fire resistance will not be reduced.

Exceptions:

1. Membrane penetrations by steel, ferrous or copper conduits, pipes, tubes or vents, or concrete or masonry items where the annular space is protected either in accordance with Subsection 707.10.4.1.1 or to prevent the free passage of flame and the products of combustion. The aggregate area of the openings through the membrane shall not exceed 100 square inches in any 100 square feet of ceiling area in assemblies tested without penetrations.
2. Ceiling membrane penetrations of maximum 2-hour horizontal assemblies by steel electrical boxes that do not exceed 16 square inches in area, provided the aggregate area of such penetrations does not exceed 100 square inches in any 100 square feet of ceiling area, and the annular space between the ceiling membrane and the box does not exceed $\frac{1}{8}$ inch.

3. Membrane penetrations by electrical boxes of any size or type, which have been listed as part of an opening protective material system for use in horizontal assemblies and are installed in accordance with the instructions included in the listing.
4. Membrane penetrations by listed electrical boxes of any material, provided such boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing. The annular space between the ceiling membrane and the box shall not exceed $\frac{1}{8}$ inch unless listed otherwise.
5. The annular space created by the penetration of a fire sprinkler, provided it is covered by a metal escutcheon plate.
6. Noncombustible items that are cast into concrete building elements and that do not penetrate both top and bottom surfaces of the element.
7. The ceiling membrane of 1- and 2-hour fire-resistance-rated horizontal assemblies is permitted to be interrupted with the double wood top plate of a fire-resistance-rated wall assembly, provided that all penetrating items through the double top plates are protected in accordance with Subsection 707.10.4.1.1.1 or 707.10.4.1.1.2. The fire-resistance rating of the wall shall not be less than the rating of the horizontal assembly.

707.10.4.1.3 Dissimilar materials. Noncombustible penetrating items shall not connect to combustible materials beyond the point of firestopping unless it can be demonstrated that the fire-resistance integrity of the horizontal assembly is maintained.

707.10.4.2 Nonfire-resistance-rated assemblies. Penetrations of nonfire-resistance-rated floor or floor/ceiling assemblies or the ceiling membrane of a nonfire-resistance-rated roof/ceiling assembly shall meet the requirements of Subsection 703.1(c) or shall comply with Subsection 707.10.4.2.1 or 707.10.4.2.2.

707.10.4.2.1 Noncombustible penetrating items. Noncombustible penetrating items that connect not more than five stories are permitted, provided that the annular space is filled to resist the free passage of flame and the products of combustion with an approved noncombustible material or with a fill, void or cavity material that is tested and classified for use in through-penetration firestop systems.

707.10.4.2.2 Penetrating items. Penetrating items that connect not more than two stories are permitted, provided that the annular space is filled with an approved material to resist the free passage of flame and the products of combustion.

707.10.5 Penetrations in smoke barriers. Penetrations in smoke barriers shall be protected by an approved through-penetration firestop system installed and tested in accordance with the requirements of UL 1479 for air leakage. The L rating of the system measured at 0.30 inch of water in both the ambient temperature and elevated temperature tests, shall not exceed:

1. 5.0 cfm per square foot of penetration opening for each through-penetration firestop system; or
2. A total cumulative leakage of 50 cfm for any 100 square feet of wall area, or floor area.

707.11 Fire-resistant joint systems. Joints installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies shall be protected by an approved fire-resistant joint system designed to resist the passage of fire for a time period not less than the required fire-resistance rating of the wall, floor or roof in or between which it is installed. Fire-resistant joint systems shall be tested in accordance with Subsection 707.11.3.

Exception: Fire-resistant joint systems shall not be required for joints in all of the following locations:

1. Floors within a single dwelling unit.
2. Floors where the joint is protected by a shaft enclosure in accordance with Subsection 703.1(c).
3. Floors within atriums where the space adjacent to the atrium is included in the volume of the atrium for smoke control purposes.
4. Floors within malls.
5. Floors and ramps within open and enclosed parking garages or structures constructed in accordance with Subsection 508.5.
6. Mezzanine floors.
7. Walls that are permitted to have unprotected openings.
8. Roofs where openings are permitted.
9. Control joints not exceeding a maximum width of 0.625 inch and tested in accordance with ASTM E119 (EPCOT Standard 6-1) or UL 263.

707.11.1 Curtain wall assembly. The void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly shall be protected in accordance with Subsection 707.11.4.

707.11.2 Installation. A fire-resistant joint system shall be securely installed in accordance with the listing criteria in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases.

707.11.3 Fire test criteria. Fire-resistant joint systems shall be tested in accordance with the requirements of either ASTM E1966 or UL 2079. Nonsymmetrical wall joint systems shall be tested with both faces exposed to the furnace, and the assigned fire-resistance rating shall be the shortest duration obtained from the two tests. When evi-

dence is furnished to show that the wall was tested with the least fire-resistant side exposed to the furnace, subject to acceptance of the Building Official, the wall need not be subjected to tests from the opposite side.

Exception: For exterior walls with a horizontal fire separation distance greater than 5 feet, the joint system shall be required to be tested for interior fire exposure only.

707.11.4 Exterior curtain wall/floor intersection. Where fire resistance-rated floor or floor/ceiling assemblies are required, voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies shall be sealed with an approved system to prevent the interior spread of fire. Such systems shall be securely installed and tested in accordance with ASTM E2307 to provide an F rating for a time period at least equal to the fire-resistance rating of the floor assembly. Height and fire-resistance requirements for curtain wall spandrels shall comply with Subsection 707.3(b).

Exception: Voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies where the vision glass extends to the finished floor level shall be permitted to be sealed with an approved material to prevent the interior spread of fire. Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E119 (EPCOT Standard 6-1) time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch of water column for the time period at least equal to the fire-resistance rating of the floor assembly.

707.11.4.1 Exterior curtain wall/nonfire-resistance-rated floor assembly intersections. Voids created at the intersection of exterior curtain wall assemblies and nonfire-resistance-rated floor or floor/ceiling assemblies shall be sealed with an approved material or system to retard the interior spread of fire and hot gases between stories.

707.11.5 Spandrel wall. Height and fire-resistance requirements for curtain wall spandrels shall comply with Subsection 707.3(b). Where Subsection 707.3(b) does not require a fire-resistance-rated spandrel wall, the requirements of Subsection 707.11.4 shall still apply to the intersection between the spandrel wall and the floor.

707.11.6 Fire-resistant joint systems in smoke barriers. Fire-resistant joint systems in smoke barriers, and joints at the intersection of a horizontal smoke barrier and an exterior curtain wall, shall be tested in accordance with the requirements of UL 2079 for air leakage. The L rating of the joint system shall not exceed 5 cfm per linear foot of joint at 0.30 inch of water for both the ambient temperature and elevated temperature tests.

SECTION 708 FIRE DIVISION WALLS

708.1 Fire division walls defined. For the purpose of this Code, the terms area separation, fire wall and fire division

wall are synonymous and shall have the meaning as defined in Chapter 2 for fire division wall.

708.2 Requirements for fire division walls. Each part of a building separated by one or more fire division walls may be considered a separate building when the fire division wall meets the following requirements:

- (a) Fire division walls shall be of not less than 3-hour fire-resistive construction in buildings of all types of construction.
- (b) The total width of all openings in fire division walls shall not exceed 25 percent of the length of the wall in each story. No single opening shall exceed 120 square feet.
- (c) All openings shall be protected by an approved opening protective having a 3-hour fire-resistive rating.
- (d) Fire division walls need not extend to the outer edges of horizontal projecting elements, such as balconies, roof overhangs, canopies, marquees or architectural projections, when the exterior wall at the terminus of the area fire division wall and projecting elements above are not less than 1-hour fire-resistive construction without openings for a width equal to the depth of the projecting elements, with a minimum of 5 feet projection.
- (e) Fire division walls shall extend from the foundation to a point at least 36 inches above the roof. Alternative methods may be used as follows:
 1. Fire division walls may terminate tight against the underside of noncombustible sheathing when the roof is of at least 2-hour fire-resistive construction.
 2. Where a fire division wall separates parts of a building having different heights, such wall may terminate at a point 36 inches above the lower roof level when the exterior wall for a height of 10 feet above the lower roof is 1-hour fire-resistive construction with openings protected by a $\frac{3}{4}$ -hour-fixed or automatic-opening protective.
 3. As an alternative to the requirement of Paragraph 2, the fire division wall may terminate at the sheathing of the lower roof when the wall is without openings and when the roof is of at least 1-hour fire-resistive noncombustible construction for a width of at least 10 feet, measured from the wall.
- (f) See Chapter 5 for special occupancy requirements. See Chapter 6 for requirements for the types of construction. See EPCOT Standard 7-1 for regulations covering fire dampers in air ducts penetrating area separations.

708.3 Hazardous utilities.

- (a) Each building having fire division walls, or occupancy or tenant separations shall have individual feeders, switches and shutoff valves for each part of the building as required by the *EPCOT Electrical Code*, the *EPCOT Plumbing Code* and the *EPCOT Mechanical Code* unless otherwise approved by the Building Official.
- (b) Other utilities that may constitute a hazard shall be regulated by the applicable requirements of this Code and shall be subject to additional requirements as the Building Official may specify.

SECTION 709 PARTITIONS

709.1 Permanent and partial partitions.

- (a) All bearing and nonbearing partitions shall be constructed as required in Table 6.2 and shall be of materials consistent with the type of construction of the building. Partitions shall provide the fire protection required for use as exit access corridors, exit enclosures, exit passageways, horizontal exits, vertical enclosures, and tenant and occupancy separations. When partitions are required to have a fire-resistance rating and protected openings, they shall be permanently identified with signs or stenciling located above any decorative ceiling and in concealed spaces. Such identification shall be provided at least every 20 feet in a horizontal direction along the partition and shall contain words to the effect "FIRE AND SMOKE BARRIER PROTECT ALL OPENINGS" in letters 2 inches high minimum. Interior nonbearing partitions of Types I, II and IV construction may be approved fire-retardant-treated wood.
- (b) Interior-bearing partitions of combustible construction shall support not more than two floors and a roof.
- (c) Regardless of the requirements for fire-resistive protection of bearing and nonbearing, partial or full-height partitions dividing an area occupied by a single tenant and which does not establish a corridor serving an occupant load of 30 or more, may be constructed of the following materials:
 - 1. Noncombustible materials.
 - 2. One-hour fire-resistive construction.
 - 3. Approved fire-retardant-treated wood.
 - 4. Wood panels or similar light construction up to three-fourths the height of the room in which they are located. When more than three-fourths the height of the room such partitions shall have not less than the upper one-fourth of the partition of glass.
 - 5. Approved plastics as provided in Section 1008 and as defined in Subsection 1008.3.

709.2 Folding, portable, sliding or collapsing partitions. Approved folding, portable, sliding or collapsing partitions without a fire-resistive rating may be used as room dividers when such partitions comply with the requirements of this Subsection.

- (a) The partitions shall not establish an exit corridor. Exits complying with the requirements of Chapter 8 shall be provided for each section or division.
- (b) All elements shall be equivalent of materials required for permanent partitions.
- (c) Interior wall finish shall comply with the requirements of EPCOT Standard 6-3 and Section 711.
- (d) Location shall be restricted by permanent tracks or guides.
- (e) Uses shall be restricted to rooms occupied by one tenant only.

- (f) Relocation shall be impossible without the use of tools.
- (g) Installation shall not violate or conflict with other provisions of this Code.

709.3 Combustible materials in concealed spaces. Combustible materials may be installed in concealed spaces.

Exception: Combustible materials located within concealed spaces in Type I, II or IV construction must comply with the following:

- 1. Materials complying with Subsection 609.1.2 of the *EPCOT Mechanical Code*.
- 2. Class I interior finish materials.
- 3. Fire-retardant-treated wood used in accordance with Table 6.2 and wood used in accordance with Section 709.
- 4. Floor finish complying with Subsections 705.2 and 711.9.
- 5. Conduit or raceway systems complying with Subsection 707.10.
- 6. Foam plastic insulation complying with Section 717.
- 7. Thermal insulation materials complying with Section 1011.
- 8. Combustible piping within partitions or enclosed shafts installed in accordance with the provision of this Code. Combustible piping may also be used within concealed ceiling spaces when approved.

709.3.1 Combustibles in plenums. The use of combustible materials in plenums shall be restricted in accordance with the *EPCOT Mechanical Code*.

SECTION 710 VENEER

710.1 Scope. All veneer and its application shall conform to the requirements of this Code and EPCOT Standard 7-8. Wainscots not more than 4 feet high, measured above the finish floor elevation for interior veneer, may be exempted from the provisions of this Section, when approved by the Building Official.

710.2 Design. The design of veneer shall comply with the requirements of Subsection 904.2 and with the following provisions:

- (a) Veneer shall support no load other than its own weight and the vertical dead load of the veneer above.
- (b) Surfaces to which veneer is attached shall be designed to support the additional vertical and lateral loads imposed by the veneer. Consideration shall be given for differential movement of supports, including that caused by temperature changes, shrinkage, creep and deflection.
- (c) Exterior veneer shall not be attached to wood frame construction at a point more than 20 feet above the adjacent ground elevation, except when approved by the Building Official, and considering special construction designed to provide for differential settlement.

710.3 Materials.

- (a) Materials used in the application of veneer may be any material approved by the Building Official. Such material shall conform to the applicable requirements for the material as specified in Chapter 10 and EPCOT Standard 7-8.
- (b) Anchors, supports and ties shall be noncombustible and corrosion resistant.

710.4 Application. Application of veneer shall conform to the requirements of EPCOT Standard 7-8.

710.5 Definitions. For the purpose of this Section and EPCOT Standard 7-8, terms used shall have the following meanings:

- (a) **Backing.** Surface or assembly to which veneer is attached.
- (b) **Veneer.** Nonstructural facing of brick, concrete, stone, tile, metal, glass, plastic or other approved material attached to a backing for ornamentation, weather protection or insulation.
 - 1. **Adhered veneer.** Veneer secured and supported through adhesion to an approved bonding material applied over an approved backing.
 - 2. **Anchored veneer.** Veneer secured to and supported by approved mechanical fasteners attached to an approved backing.
 - 3. **Exterior veneer.** Veneer applied to weather-exposed surface.
 - 4. **Interior veneer.** Veneer applied to surfaces other than weather-exposed surfaces.

710.6 Adhered veneer.

- (a) Backing shall be continuous and may be of any material permitted by this Code. It shall have surfaces prepared to secure and support the imposed loads of the veneer. Exterior veneer, including the backing, shall provide a weather-protected covering. (For additional requirements for weather protection, see Subsection 503.10.)
- (b) The height and length of adhered veneered areas shall be unlimited, except as required to control expansion and contraction, and as limited in Subsection 710.2(c).
- (c) Veneer units shall not exceed 36 inches in the longest dimension, nor more than 720 square inches in total area and shall weigh not more than 15 pounds per square foot (psf), except as approved by the Building Official.

Exception: Veneer units weighing less than 3 psf shall not be limited in dimension or area.

710.7 Anchored veneer.

- (a) Backing may be of any material permitted by this Code. Exterior veneer, including its backing, shall provide a weather-protected covering.
- (b) Anchored veneer shall be supported on footings, foundations or other noncombustible supports. Where anchored veneer is applied more than 20 feet above the adjacent ground elevation, it shall be supported by noncombustible, corrosion-resistant structural framing

having horizontal supports spaced not more than 12 feet vertically above the 20-foot height.

- (c) Noncombustible, corrosion-resistant lintels and noncombustible supports shall be provided over all openings where the veneer unit is not self-spanning. The deflections of all structural lintels and horizontal supports required by this Subsection shall not exceed $\frac{1}{500}$ of the span under full load of the veneer.
- (d) The area and length of anchored veneer walls shall be unlimited, except as required to control expansion and contraction, and by Subsection 710.2(c).

SECTION 711 INTERIOR FINISHES

711.1 Scope. Provisions of this Section shall govern the use of materials used as interior finishes, trim and decorative materials.

711.2 Conforming materials. Materials used for wall and ceiling interior finishes shall conform to the requirements of this Section and EPCOT Standard 6-3 and 6-4.

711.3 Definitions:

- (a) **Decorative materials.** All materials applied over the building interior finish for decorative, acoustical or other effect (such as curtains, draperies, fabrics, streamers and surface coverings), and all other materials utilized for decorative effect (such as batting, cloth, cotton, hay, stalks, straw, vines, leaves, trees, moss, and similar items), including foam plastics and materials containing foam plastics. Decorative materials do not include floor coverings, ordinary window shades, interior finish and materials 0.036 inch or less in thickness applied directly to and adhered tightly to a substrate.
- (b) **Interior finish.** Interior finish includes interior wall and ceiling finish and interior floor finish.
- (c) **Interior floor finish.** The exposed floor surfaces of buildings including coverings over a finished floor or stair, including risers.
- (d) **Interior wall and ceiling finish.** The exposed interior surfaces of buildings including, but not limited to, fixed or movable walls and partitions; toilet room privacy partitions; columns; ceilings; and interior wainscoting, paneling or other finish applied structurally or for decoration, acoustical surface insulation, structural fire resistance or similar purposes, but not including trim.
- (e) **Smoke-developed index.** A comparative measure, expressed as a dimensionless number, derived from measurements of smoke obscuration versus time for a material tested in accordance with EPCOT Standard 6-3 or 6-4.
- (f) **Trim.** Picture molds, chair rails, baseboards, handrails, door and window frames and similar decorative or protective materials used in fixed applications.

711.4 Decorative materials and trim. Decorative materials and trim shall be restricted by the combustibility and flame propagation performance criteria of NFPA 701, in accordance with Subsection 711.5.

711.5 Material testing.

- (a) Tests shall be made by an approved testing agency to establish flame spread characteristics and shall substantiate that materials, when cemented or otherwise fastened in place, will not become detached readily when subjected to room temperatures of 300°F for 25 minutes.
- (b) Flame spread characteristics of wall and ceiling finishes shall be determined by one of the following methods:
 1. The tunnel test as specified in EPCOT Standard 6-3 or 6-4.
 2. Any other nationally recognized test procedure for determining the flame spread characteristics of finish materials that will give comparable results to that specified in Paragraph (1).
- (c) Material classification based on the tunnel test shall meet the requirements of Table 7.4. All interior finish materials regulated by this Section shall be approved by the Building Official. In determining the acceptability of a material, the Building Official may consider the toxicity of the materials according to such evidence as he considers appropriate to the approval.

711.6 Application of interior finish. Interior finish materials applied to walls and ceilings shall be tested as specified in Subsection 711.3 and shall conform to the requirements of this Subsection.

- (a) When walls and ceilings are required by provisions of this Code to be of fire-resistive or noncombustible construction or fire-retardant-treated wood, the finish material shall be applied directly against the surface. Intervening spaces between furring strips shall be filled with inorganic or Class I finish materials (see Tables 7.3 and 7.4) or shall be firestopped not to exceed 8 feet in any direction.
- (b) Where walls and ceilings are required to be of fire-resistive or noncombustible construction or fire-retardant-treated wood and walls are set out or ceilings are dropped distances greater than specified in Paragraph (a), Class I finish materials (see Tables 7.3 and 7.4) shall be used, except where the finish materials are protected on both sides by an automatic sprinkler system or are attached to a noncombustible backing, or the furring strips installed as specified in Paragraph (a). Hangars and assembly members of such dropped ceilings that are below the main ceiling line shall be of noncombustible materials. The construction of each set out wall shall be of fire-resistive construction as required elsewhere in this Code. (See Subsections 705.5 and 707.9 for draftstops and firestops, respectively.)
- (c) All finish materials may be installed directly against wood decking, heavy timber, planking or to wood furring strips applied as specified in Paragraph (b).
- (d) All interior finish, other than Class I materials, less than 1/4 inch thick, shall be applied directly against a

noncombustible backing, unless the qualifying tests were made with the material suspended from the noncombustible backing.

TABLE 7.3
FLAME SPREAD CLASSIFICATION
Material Qualified By:

CLASS	TUNNEL TEST ^a
I	0 – 25
II	26 – 75
III	76 – 200
IV	200 – 500

a. Smoke developed index: 0 – 450.

TABLE 7.4
MINIMUM INTERIOR FINISH CLASSIFICATION^a

OCCUPANCY GROUP	ENCLOSED VERTICAL EXITWAYS	OTHER EXITWAYS	ROOMS OR AREAS
A-1 – A-6	I	II	III
B	I	II	III
D	I	I	I
E	I	II	III
H	I	II	III
R-1 – R-2	I	II	III
R-3	III	III	III
S	No Restrictions		

a. See Subsection 719.11.

711.7 Finishes based on occupancy.

- (a) The minimum interior flame spread classification as determined by tests shall be based on use or occupancy as set forth in Table 7.4.
- (b) Except in Group D occupancies and in enclosed vertical exitways, Class III finishes may be used as wainscoting and for tack and bulletin boards. In such applications, the wall finish shall extend not more than 48 inches above the floor and shall cover not more than 5 percent of the gross wall area of the room.
- (c) The exposed faces of structural members in buildings of Type III construction, and decking and planking, where permitted by other provisions of this Code, are exempted from flame spread requirements.

711.8 Interior trim. Material, other than foam plastic used as interior trim, shall have a minimum Class III flame spread and smoke developed index when tested in accordance with Standard 6-3 or 6-4. Combustible trim, excluding handrails and guardrails, shall not exceed 10 percent of the specific wall or ceiling area in which it is attached. Unprotected wood doors and windows may be used, except where openings are required to be fire protected.

711.9 Carpet on walls and ceilings. Carpeting and similar materials having a napped, tufted, looped or similar surface may be used as interior finish on walls and ceilings only when it has a flame spread rating of 25 or less in accordance with ASTM E84.

711.10 Floor finish.

- (a) In buildings of Type I or II construction, floor finish, if of combustible material, shall be applied directly upon the floor construction, except that a floor finish of wood, linoleum, rubber, tile or cork may be secured to a subfloor of wood. Where wood sleepers are used for laying wood floors or subfloors in such buildings, they shall be firestopped so that there will not be an open space extending under any permanent partition. Where wood sleepers are used and the space between the floor slab and the underside of the floor or subfloor is more than 2½ inches, such space shall be filled with non-combustible material so that such space is not more than 2½ inches.
- (b) Combustible insulating boards may be used for sound deadening or insulating of floors, except that in buildings required to be of Type I or II construction, such insulating boards shall not be more than ½ inch thick and cemented directly to the floor slab or secured to wood sleepers firestopped as called for in Paragraph (a) and covered with approved finish flooring.

711.11 Floor covering.

- (a) Finished floors or floor covering materials of a traditional type, such as wood, vinyl, linoleum terrazzo and other resilient floor covering materials, are exempt from the requirements of this Section. Carpet-type floor coverings shall be tested as proposed for use including underlayment.
- (b) Carpet materials used on floors of exit access corridors and enclosed exits, shall satisfactorily withstand a minimum critical radiant flux of 0.22 watts per square centimeter when tested in accordance with NFPA 253.
- (c) All carpet required by this Code to meet critical radiant flux limits established by NFPA 253 shall have been tested by an approved laboratory. A copy of the test report representing the style shall be provided to the Building Official upon request. The test report shall identify the carpet by manufacturer or supplier and style name, and shall be representative of the current construction of the carpet.
- (d) The carpet shall be identified by a hang tag or other suitable method as to manufacturer or supplier and style, and shall indicate the critical radiant flux level.

711.12 Combustible decorative materials. The permissible amount of decorative materials meeting the flame propagation performance criteria of NFPA 701 shall not exceed 10 percent of the specified wall or ceiling area to which it is attached.

SECTION 712 MAXIMUM FLOOR AREAS

712.1 Areas of buildings.

- (a) The area of buildings shall not exceed the limits set forth in Table 7.5, except as permitted in this Subsection.
- (b) Basements of one-story buildings need not be included in the total area permitted when such basement is not a story as defined in Chapter 2. The area of a basement

shall not exceed that permitted for a one-story building permitted for the type of construction and occupancy.

- (c) The area of a single floor of a multiple-story building shall not exceed the area permitted for a one-story building.
- (d) Where two or more types of construction not separated by fire walls occur in the same building, the area of the entire building shall not exceed the least area permitted based on occupancy for the types of construction used in the building.

712.2 Area increases permitted. The floor areas specified in Subsection 712.1 may be increased under the conditions specified in this Subsection. Such increases shall not exceed 100 percent, except in buildings of more than two stories housing Group I occupancies and one-story buildings housing aircraft storage hangars, and as further limited in Section 511 for aircraft repair hangars.

For the purposes of determining an increase in allowable floor area, permanent open yards include a public street, fire lane, public way, or public space providing direct access to a public street, fire lane, or public way. For the purposes of this Subsection, waterways and service courts shall not be considered to be part of a permanent open yard.

- (a) **Separation on two sides.** Where public space, streets or permanent open yards more than 20 feet wide extend along and adjoin two sides of the building, but not less than 50 percent of the perimeter of the building, floor areas may be increased at the rate of 1.25 percent for each foot by which the minimum width exceeds 20 feet. The increase shall be not more than 50 percent.
- (b) **Separation on three sides.** Where public space, streets or permanent open yards more than 20 feet wide extend along and adjoin three sides of the building, but not less than 75 percent of the perimeter of the building, floor areas may be increased at the rate 2.5 percent for each foot by which the minimum width exceeds 20 feet. The increase shall be not more than 100 percent.
- (c) **Separation on all sides.** Where public space, streets or permanent open yards more than 20 feet wide extend on all sides of the building and adjoin the entire perimeter, floor areas may be increased at the rate of 5 percent for each foot by which the minimum width exceeds 20 feet. The increase shall be not more than 100 percent.
- (d) **Automatic vents.** In one-story buildings, the area specified in Table 7.5 for Group B-1 and I occupancies may be increased 25 percent when at least 75 percent of the building and all rooms with an area more than 10,000 square feet are provided with venting systems complying with EPCOT Standard 7-9. The area increases permitted in this Subsection may be compounded with area increases permitted in other Subsections of this Section.
- (e) **Fire-retardant-treated wood.** One-story buildings of Types V and VI construction, with all structural wood members of approved fire-retardant-treated lumber, may have a 25-percent increase in the basic area.

TABLE 7.5
BASIC FLOOR AREAS AND HEIGHTS OF BUILDINGS
FOR TYPES I, II, III, IV, V and VI CONSTRUCTION^a

TYPE I				TYPE II			TYPE III			TYPE IV						TYPE V						TYPE VI					
Occupancy Group	Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)	PROTECTED		UNPROTECTED		PROTECTED		UNPROTECTED		PROTECTED		UNPROTECTED		PROTECTED		UNPROTECTED						
							Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)	Number of Stories	Height (feet)	Area First Floor (square feet)
A-1	NL	NL	NL	6	110	40,000	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP			
A-2	NL	NL	NL	6	110	40,000	2	50	20,000	3	60	22,000	2	50	14,000	3	60	17,000	2	50	11,000	2	50	8,000			
A-3	NL	NL	NL	6	110	40,000	2	50	20,000	3	60	22,000	2	50	14,000	3	60	17,000	2	50	11,000	2	50	8,000			
A-4	NL	NL	NL	6	110	80,000	3	60	40,000	3	60	45,000	2	40	31,000	3	60	36,000	2	40	24,000	2	40	18,000			
A-5	NL	NL	NL	6	110	40,000	3	50	20,000	3	60	22,000	2	50	14,000	3	60	17,000	2	50	11,000	2	50	8,000			
A-6	NL	NL	NL	NA	NA	NA	NA	50	32,000	NA	30	24,000	NA	30	8,000	NA	50	12,000	NA	40	6,000	NA	20	4,000			
A-7	NL	NL	NL	NA	NA	NA	NA	50	32,000	NA	30	24,000	NA	30	8,000	NA	50	12,000	NA	40	6,000	NA	20	4,000			
A-8 ^a																											
A-9 ^a																											
B-1,2	NL	NL	NL	11	110	50,000	4	55	30,000	4	55	37,000	4	55	26,000	4	55	29,000	3	45	24,000	2	30	12,000			
B-3	NL	NL	NL	9	110	60,000	4	55	33,000	5	65	40,000	4	45	26,000	4	55	31,000	3	45	24,000	2	30	12,000			
B-4	NL	NL	NL	2	110	100,000	2	60	40,000	2	60	45,000	2	45	30,000	2	55	36,000	2	45	24,000	2	30	14,000			
D-1	NL	NL	NL	3	30	20,000	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP			
D-2, 3	NL	NL	NL	4	45	20,000	3	35	13,000	3	35	15,000	2	25	12,000	3	35	12,000	2	25	8,000	2	25	8,000			
E-1, 2	NL	NL	NL	5	60	60,000	3	35	40,000	2	25	27,000	3	35	27,000	3	35	36,000	2	25	24,000	2	25	16,000			
E-3	NL	NL	NL	3	35	60,000	3	35	41,000	3	35	40,000	2	25	27,000	3	35	36,000	2	25	24,000	2	25	16,000			
H-1	6	60	30,000	3	35	16,000	2	25	11,000	3	35	12,000	2	25	8,000	3	35	9,000	2	25	6,000	NP	NP	NP			
H-2	6	60	30,000	3	35	16,000	2	25	11,000	3	35	12,000	2	25	8,000	3	35	9,000	2	25	6,000	2	25	4,000			
H-3	NL	NL	NL	3	40	30,000	3	40	22,000	3	40	22,000	2	30	15,000	3	40	18,000	2	30	12,000	2	30	8,000			
H-4	NL	NL	NL	2	60	100,000	2	45	40,000	2	45	40,000	2	45	20,000	2	45	30,000	2	30	13,000	2	30	10,000			
I-1	NL	NL	NL	7	85	80,000	4	50	35,000	4	50	36,000	3	35	24,000	4	50	28,000	3	35	19,000	2	25	8,000			
I-2, I-3	NL	NL	NL	7	85	80,000	5	60	50,000	4	50	52,000	3	35	35,000	4	50	42,000	3	35	21,000	4	35	16,000			
R-1, 2	NL	NL	NL	11	110	40,000	4	45	27,000	4	45	30,000	3	35	20,000	4	45	27,000	4	35	18,000	3	25	14,000			
R-3	NL	NL	NL	11	110	40,000	4	45	25,000	4	45	30,000	4	45	20,000	4	45	24,000	4	45	16,000	4	45	14,000			
S ^{c,e}																											

NL = Not limited

NP = Not permitted

NA = Not applicable

a. See Section 712 for area increase permitted.

b. See Section 507.

c. See Subsection 516.2.

d. See Appendix M.

e. See Appendix Q.

712.3 Unlimited area.

- (a) Except in hazardous locations, the area of one-story buildings housing Group B, Group H, Division 4, and Group I occupancies shall not be limited when the building is surrounded and adjoined by public space, streets or permanent yards not less than 60 feet wide.
- (b) Buildings described in Paragraph (a) used for factories, workshops or warehouses shall be provided with automatic venting systems in accordance with the requirements of Subsections 511.2(b), 512.4(c) and Section 716. Automatic venting systems shall comply with the *EPCOT Mechanical Code* and EPCOT Standard 7-9.

SECTION 713 MAXIMUM HEIGHT OF BUILDINGS

713.1 Height and number of stories.

- (a) The maximum height and number of stories of every building shall depend on the use and occupancy of the building and on the type of construction, and shall not exceed the limits specified in Table 7.5, except as provided in this Section.
- (b) The height of a building shall be measured from the highest adjoining sidewalk or ground surface, provided that the height measured from the lowest adjoining surface shall not exceed the maximum height permitted for the building by more than 10 feet.
- (c) Where two or more types of construction occur in the same building, the height of the entire building shall not exceed the least height permitted based on the occupancy for the types of construction used in the building.
- (d) **Mezzanines.** There shall be not more than two mezzanine levels in a room. Clear height above or below a mezzanine floor shall be not less than 7 feet.

713.2 Height increases.

- (a) Towers, spires and steeples erected as part of a building and not used for habitation or storage shall be limited in height only by the requirements of this Code for structural design and when constructed entirely of noncombustible materials, but such structures shall extend not more than 20 feet above the height limit permitted in Table 7.5 when constructed of combustible materials.
- (b) The height of one-story aircraft hangars shall not be limited when the building is surrounded by public space, streets or permanent open yards not less in width than $1\frac{1}{2}$ times the height of the building. (See Chapter 5 for special occupancy requirements.)
- (c) When a one-story automobile parking structure, enclosed or open, of Type I or II construction, or open of Type III construction, with grade entrance, is provided under a building of Group R occupancy, the number of stories to be used in determining the minimum type of construction may be measured from the floor above such parking area. The floor/ceiling assembly shall provide the occupancy separation required in Table 5.2.

SECTION 714 SMOKE BARRIERS

714.1 General. Smoke barriers shall comply with this Section.

714.2 Materials. Smoke barriers shall be of materials permitted by the building type of construction.

714.3 Fire-resistance rating. A 1-hour fire-resistance rating is required for smoke barriers.

714.4 Continuity. Smoke barriers shall form an effective membrane continuous from outside wall to outside wall and from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, deck or slab above, including continuity through concealed spaces, such as those found above suspended ceilings, and interstitial structural and mechanical spaces. The supporting construction shall be protected to afford the required fire-resistance rating of the wall or floor supported in buildings of other than Type IV, V or VI unprotected construction.

Exception: Smoke-barrier walls are not required in interstitial spaces where such spaces are designed and constructed with ceilings that provide resistance to the passage of fire and smoke equivalent to that provided by the smoke-barrier walls.

714.5 Openings. Openings in a smoke barrier shall be protected in accordance with Section 704.

Exception: In Group E-3, where doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with fire-protection-rated glazing materials in fire-protection-rated frames, the area of which shall not exceed that tested. The doors shall be close fitting within operational tolerances, and shall not have undercuts in excess of $\frac{3}{4}$ -inch louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges and shall be automatic-closing by smoke detection in accordance with the *EPCOT Fire Prevention Code*. Where permitted by the door manufacturer's listing, positive-latching devices are not required.

714.6 Penetrations and joints. Penetrations of smoke barriers and joints made in or between smoke barriers, shall comply with Subsection 707.10.

714.7 Ducts and air transfer openings. Penetrations in a smoke barrier by ducts and air transfer openings shall comply with the *EPCOT Mechanical Code*.

SECTION 715 AUTOMATIC FIRE-EXTINGUISHING SYSTEMS

715.1 Criteria.

- (a) Fire-extinguishing systems shall be installed and maintained in operating condition in accordance with the requirements for this Section, and EPCOT Standards 7-10 through 7-17 and 7-25.
- (b) Automatic fire-extinguishing systems shall be provided with approved facilities to assure that the system is in proper operating condition. Such facilities shall be subject to review by the Chief of the Fire Department.

ment and shall include, but not be limited to, the following:

1. Electrical connections to a continuously manned central station or fire department headquarters to give notice of any closed water supply or control valve, or other condition that might interfere with operation of the system. The electrical connections shall also give notice of a flow of water in the system.
 2. Provisions for immediate alarm to the fire department in case of fire.
- (c) Hose threads used in connection with fire-extinguishing systems shall be national standard threads.
 - (d) Fire-extinguishing systems, including automatic sprinkler systems, combination standpipes, fire department standpipes, wet standpipes and special systems, shall be approved. They shall also be subject to periodic tests as required by the Chief of the Fire Department.
 - (e) Above-ground sprinkler piping shall be flushed prior to final acceptance.
 - (f) When permitted by the Building Official, a dry-pipe system, complying with EPCOT Standard 7-10, may be installed in areas subject to freezing.
 - (g) Hydrostatic test shall be performed prior to installation of sprinkler heads unless otherwise approved by the Building Official.
 - (h) In buildings three or more stories in height, sprinkler systems shall be zoned separately for every floor.

➔ **715.2 Definitions.** For the purpose of this Code, the following definitions shall apply to fire-extinguishing systems and their connections:

- (a) **Automatic fire-extinguishing system.** A sprinkler, dry-powder, carbon-dioxide, halon or other system complying with EPCOT Standards 7-10, 7-11, 7-12, 7-13 and 7-16, the use of which is appropriate to the fire hazard involved.
- (b) **Automatic sprinkler system.** A fire-extinguishing system having an approved water supply with all control valves electrically supervised and in compliance with EPCOT Standard 7-10. All underground piping shall be rated a minimum 200 pounds per square inch (psi).
- (c) **Dry-pipe system.** A system employing automatic sprinklers attached to a piping system containing air under pressure.
- (d) **Fire department sprinkler connection.** A connection in an accessible location through which the fire department can pump water into a sprinkler system.
- (e) **Standpipes.**
 1. **Class I system.** A Class I system shall provide a 2½-inch hose outlet to supply water for use by the fire department and those trained in handling heavy streams.
 2. **Class II system.** A Class II system shall provide a 1½-inch hose outlet to supply water for use pri-

marily by the building occupants or by the fire department during initial response.

3. **Class III system.** A Class III system shall provide a 1½-inch hose outlet to supply water for use by building occupants and a 2½-inch hose outlet to supply a larger volume of water for use by the fire department and those trained in handling heavy streams.
4. **Combination standpipe.** An approved system designed and supplied from the automatic sprinkler system.
5. **Dry standpipe.** Not approved in the District.

715.3 Detailed requirements.

- (a) **Water supply.** Automatic sprinkler systems shall be connected to an approved water supply of adequate pressure, capacity and reliability for the requirements of the system.
- (b) **Connections.** Automatic sprinkler systems may be connected to the domestic water supply main when approved by the Building Official, and when the domestic water supply is reliable and has sufficient pressure, capacity and pipe sizing for the combined domestic and sprinkler system requirements. When connected to the domestic water supply, the connection between the public water main and the sprinkler system shall be made between the main or meter and the shutoff valve of the building with no intervening valves or connections.
- (c) **Water flow alarm.** The water flow alarm device required in Subsection 715.1(b) may be omitted when approved by the Building Official if the sprinkler system serves less than six sprinkler heads.

715.4 Where automatic sprinkler systems are required.

- (a) An automatic sprinkler system shall be required throughout every building. The system shall be installed and maintained in operating condition in accordance with EPCOT Standards 7-10 through 7-24. Automatic sprinkler systems shall be installed in the following locations as specified in this Chapter and as set forth in Subsection 503.12.
- (b) In every story and basement of all buildings.
- (c) Sprinkler protection shall be required on every floor of any enclosed exit stairway and in closets and bathrooms of Group R-1, R-2 and R-3 occupancies.

Exceptions:

1. An automatic sprinkler system shall be required for Group R-2 and R-3 occupancies, in accordance with EPCOT Standard 7-10 or 7-10A. Any Group R-3 occupancy where the total floor area of the building is less than 2,000 square feet shall be exempt.
2. Sprinklers installed within sleeping areas of Group R occupancies shall be of the listed residential type.
3. Where an area is used for storage of permanent telephone equipment, computers, transformer vaults or similar installations, fire-extinguish-

ing systems, where required, shall be of a type that the installation or storage will not be damaged. A preaction system shall also be provided in these areas for building structural protection. Sprinklers may be omitted in non-combustible vaults less than 800 square feet if a smoke detection system is installed.

4. In Group D occupancies, increases permitted by Sections 712 and 713 shall apply. In areas used by patients, an approved device for detecting products of combustion other than heat may be installed in lieu of an automatic sprinkler system, but the increases in height and area provided in Sections 712 and 713 for protection by an automatic fire-extinguishing system shall not be permitted. In jails, prisons and reformatories, the sprinkler system may be manually controlled.
5. In Group S occupancies, satellite structures shall be exempt from requirements for automatic sprinkler protection. [See Subsection 503.12(b).]
6. Open parking garages meeting the requirements of Subsection 508.5.

715.5 Fire department standpipes.

- (a) Fire department standpipes, as defined in Subsection 715.2, shall be constructed and installed as required in EPCOT Standard 7-14 and this Subsection.
- (b) All buildings of three or more stories shall be equipped with one or more fire department standpipes. The standpipes may be connected to the automatic sprinkler systems as provided in EPCOT Standard 7-10.
- (c) There shall be one fire department or combination standpipe outlet connection installed at every floor level of every required enclosed stairway or smoke-protected enclosure.
- (d) An approved, durable sign with raised letters at least 1 inch high reading "FIRE DEPARTMENT STANDPIPE" shall be permanently attached to all fire department standpipe connections.
- (e) Fire department standpipes extending from the basement to the top story shall be provided in Group A, Division 1, 2 and 3 occupancies, with an occupant load of more than 1,000; in Group B, D, E, H and I occupancies; and in Group R-1 occupancies more than three stories in height.
- (f) Fire department standpipes shall be located so that all parts of the building are within 20 feet of a nozzle attached to 100 feet of hose. In Group A, Division 1, 2 and 3 occupancies, with an occupant load of more than 1,000, outlets shall be located on each side of the rear of the auditorium and each side of the balcony.
- (g) Fire department standpipes may be supplied by the same main as the fire-extinguishing system.

- (h) Fire department standpipes shall be provided with approved monitoring systems in compliance with Subsection 715.1(b)1.

715.6 Combination standpipes.

- (a) Combination standpipes, as defined in Subsection 715.2, shall be constructed and installed as required in EPCOT Standard 7-14 and this Subsection.
- (b) When a combination standpipe system is installed in accordance with this Subsection, a separate fire department standpipe system need not be installed. One combination standpipe shall be installed for every required stairway or smoke-protected enclosure that extends from the ground floor to the roof in all buildings four or more stories in height.
- (c) Combination standpipe systems outlets may be outside the stair enclosure but shall be immediately adjacent thereto. When a smoke-protected enclosure is provided, the standpipe connection shall be in the vestibule, except as otherwise approved by the Building Official.
- (d) In buildings where more than one combination standpipe system is installed, the system shall be cross connected at the bottom.
- (e) Water supply and construction shall be as required in EPCOT Standard 7-14.
- (f) An approved durable sign with raised letters at least 1 inch high reading "COMBINATION STANDPIPE" shall be permanently attached to all fire department standpipe connections.

715.7 Fire protection of buildings under construction.

- (a) During construction of a building and until the permanent fire-extinguishing system is in service, fire protection shall be provided in accordance with the requirements set forth in this Subsection, Appendix F, EPCOT Standard 7-14 and the *EPCOT Fire Prevention Code*.
- (b) In buildings exceeding three stories, not less than one wet standpipe shall be installed for use of the fire department during construction of the building. When any point in a building shall be more than 100 feet from the standpipe outlet, additional standpipes shall be provided.
- (c) Standpipes of not less than 4 inches shall be installed when the construction has progressed above the third-floor level or 50 feet above grade, whichever is reached first.
- (d) Standpipes shall be equipped with 2½-inch siamese fire department inlet connections at locations accessible to fire department pumping apparatus and serving a stairway that is usable during construction. Standpipe systems shall be extended as construction progresses to within one floor of the highest point where secured decking or flooring has been constructed.
- (e) A 2½-inch valved hose outlet reduced to a 1½-inch hose outlet shall be installed at each floor conforming to the requirements of EPCOT Standard 7-14.

- (f) Free access from the street to fire hydrants, and to outside connections for standpipes, sprinklers or other fire-extinguishing equipment, whether permanent or temporary, shall be provided and maintained at all times. During building operations, free access to permanent, temporary or portable first aid fire equipment, shall be maintained at all times. During construction, when combustibles are brought on to the site in such quantities as deemed hazardous by the Fire Official, access roads and a suitable temporary supply of water acceptable to the fire department shall be provided and maintained.
- (g) All premises, where buildings or portions of buildings other than dwellings are located more than 150 feet from a public street providing access to such premises, shall be provided with approved fire hydrants connected to a water system capable of supplying the fire flow required by the Building Official. The location and number of such hydrants shall be as designated by the Fire Official.
- (h) Each hose outlet shall be equipped with 100 feet of rubber-lined hose and an adjustable nozzle. Hose shall be stored in an approved rack and be preconnected, ready for use at all times during construction. The rack shall be provided with a sign reading: "FIRE HOSE FOR EMERGENCY USE ONLY."
- (i) It shall be unlawful to use, tamper with or attach any type of a device to a fire department standpipe for other than emergency fire-fighting purposes.
- (j) Temporary standpipes may be installed in lieu of permanent standpipes during construction. Temporary standpipes shall remain in service until the permanent system is in service.
- (k) When construction height requires the installation of a fire pump, a fire pump equipped with automatic starting equipment shall be installed to maintain a minimum supply of 75 gallons of water per minute at 50 psi at each standpipe location at all times during construction.

SECTION 716 SMOKE AND HEAT VENTING

716.1 Where required.

- (a) Smoke and heat vents shall be installed in accordance with the requirements of EPCOT Standard 7-9 and this Section. Where there is a conflict between this Section and Standard, the requirements of this Section shall apply. Smoke and heat vents shall be located as follows:
 1. In Group B and I occupancies, more than 50,000 square feet in a single floor area.
 2. In Group H occupancies, more than 15,000 square feet in single floor area.
- (b) Smoke and heat vents shall be installed in buildings housing mixed occupancies as required for the specific occupancy being considered.

716.2 Types of vents. Vents shall be fixed in the open position or shall open manually. Vents shall be located at or near the highest elevation of the ceiling, no lower than the upper one-third of the smoke curtain. Where plain glass is used, protection to occupants from glass breakage shall be provided and shall comply with Section 706. Vents shall not be located within 20 feet of the adjoining property line.

716.3 Releasing devices. Manual and/or remote control shall be provided as required by the Building Official.

716.4 Size and spacing of vents.

- (a) The effective venting area shall be the minimum cross-sectional area through which the hot gases pass to the atmosphere, and shall not be less than 16 square feet, with no dimensions less than 2 feet.
- (b) The maximum center-to-center spacing of vents in the building shall be:
 1. In Group B and I occupancies, 120 feet.
 2. In Group H occupancies, 100 feet.
- (c) Ratios of effective area of vent openings to floor area of the occupancy shall be:
 1. In Group B and I occupancies, 1 to 100.
 2. In Group H occupancies, 1 to 50.

SECTION 717 FOAM PLASTIC

717.1 General.

- (a) Use of foam plastic shall comply with the smoke density and toxicity requirements of Section 711.

717.2 Specific requirements. The following requirements shall apply to all uses of foam plastics in or on the walls, ceilings or both, unless specifically approved. Such approval shall be based on the acceptable diversified tests such as, but not limited to, tunnel tests conducted in accordance with EPCOT Standard 6-3, full-scale corner tests and an ignition temperature as set forth in EPCOT Standard 7-18.

- (a) Foam plastics having a flame spread classification of 75 or less may be used in the following locations:
 1. Within the cavity of a masonry or concrete wall.
 2. On the room side surface of conforming walls or ceilings, provided the foam plastic is fully protected from the interior of the building by a thermal barrier of 1/2-inch gypsum wallboard or other approved material having a finish rating of not less than 15 minutes as determined by EPCOT Standard 6-1. Thermal barriers shall be installed in a manner that will assure they will remain in place for 15 minutes.
 3. Within the wall cavity of combustible nonfire-resistive wall construction provided the protection is applied as described in Paragraph (b).
 4. Within the cavity of walls classified as combustible fire-resistive construction provided fire tests are conducted in accordance with EPCOT Standard 6-1 and the protection from the interior of

the building is at least equivalent to that required in Paragraph (b).

- (b) Foam plastic insulation having a flame spread classification of 75 or less when tested in a thickness of 4 inches may be used in thicknesses up to 10 inches for use in cold-storage rooms, food processing rooms, ice plant and similar rooms when the room is protected with automatic sprinklers and the insulation is covered with 1/2-inch Portland cement, plaster or other approved material having a finish rating of not less than 15 minutes as determined by EPCOT Standard 6-1. Thermal barriers shall be installed in a manner that will assure they remain in place for 15 minutes.
- (c) Foam plastics insulation on walls having a flame spread classification of 25 or less may be used in a thickness of not more than 4 inches in or on walls when the foam plastic is covered by a thickness not less than 0.032-inch aluminum or 26-gauge galvanized sheet steel and the insulated area is protected with automatic sprinklers. Such walls shall not be used where noncombustible or fire-resistive construction is required.
- (d) Foam plastics may be used as a roof covering if the foam plastic is part of a Class A, B or C roofing assembly.
- (e) Agricultural buildings used exclusively for the storage of farm produce or for the housing of livestock or poultry when such buildings have but intermittent and limited occupancy by humans, may employ the use of unprotected foam plastics having a flame spread classification of 25 or less.

SECTION 718 SPECIAL PROVISIONS—HIGH-RISE STRUCTURES

718.1 Application. These additional requirements shall apply to all buildings having a floor level used for human occupancy located more than 75 feet above the lowest level of fire department vehicle access.

718.2 Structural integrity of exit enclosures and elevator hoistway enclosures. For high-rise buildings that are Risk Category III, IV or more than 420 feet in building height, exit enclosures and elevator hoistway enclosures shall comply with Subsections 718.2.1 through 718.2.4.

718.2.1 Wall assembly. The wall assemblies making up the exit enclosures and elevator hoistway enclosures shall meet or exceed Soft Body Impact Classification Level 2 as measured by the test method described in ASTM C1629/C1629M.

718.2.2 Wall assembly materials. The face of the wall assemblies making up the exit enclosures and elevator hoistway enclosures that are not exposed to the interior of the exit enclosure or elevator hoistway enclosure shall be constructed in accordance with one of the following methods:

- (a) The wall assembly shall incorporate not less than two layers of impact-resistant construction board each of which meets or exceeds Hard Body Impact Classification Level 2 as measured by the test method described in ASTM C1629/C1629M.

- (b) The wall assembly shall incorporate not less than one layer of impact-resistant construction material that meets or exceeds Hard Body Impact Classification Level 3 as measured by the test method described in ASTM C1629/C1629M.

- (c) The wall assembly incorporates multiple layers of any material, tested in tandem, that meet or exceed Hard Body Impact Classification Level 3 as measured by the test method described in ASTM C1629/C1629M.

718.2.3 Concrete and masonry walls. Concrete or masonry walls shall be deemed to satisfy the requirements of Subsections 718.2.1 and 718.2.2.

718.2.4 Other wall assemblies. Any other wall assembly that provides impact resistance equivalent to that required by Subsections 718.2.1 and 718.2.2 for Hard Body Impact Classification Level 3, as measured by the test method described in ASTM C1629/C1629M, shall be permitted.

718.3 Sprayed fire-resistant materials (SFRM). The bond strength of the SFRM installed throughout the building shall be in accordance with Table 7.7.

TABLE 7.7
MINIMUM BOND STRENGTH

HEIGHT OF BUILDING ^a	SFRM MINIMUM BOND STRENGTH
Up to 420 feet	430 psf
Greater than 420 feet	1,000 psf

a. Above the lowest level of fire department vehicle access.

718.4 Number of sprinkler risers and system design. Each sprinkler system zone in buildings that are more than 420 feet in building height shall be supplied by a minimum of two risers. Each riser shall supply sprinklers on alternate floors. If more than two risers are provided for a zone, sprinklers on adjacent floors shall not be supplied from the same riser.

718.4.1 Riser location. Sprinkler risers shall be placed in exit enclosures that are a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building measured in a straight line between exit doors or exit access doorways. Interlocking or scissor stairs shall be counted as one exit stairway.

718.5 Fire pump room. Fire pump units serving high-rise buildings shall be protected from surrounding occupancies by a minimum of 2-hour fire-rated construction or physically separated from the protected building by a minimum of 50 feet.

718.6 Water supply to required fire pumps. Required fire pumps shall be supplied by connections to a minimum of two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will con-

tinue without interruption through at least one of the connections.

718.7 Smoke detection systems.

(a) At least one approved smoke detector suitable for the intended use shall be installed in:

1. Every mechanical equipment, electrical, transformer, telephone equipment, elevator machine or similar room.
2. Each elevator lobby at each floor, and each detector shall comply with the provisions of EPCOT Standard 5-1.
3. The main return and exhaust air plenum of each air-conditioning system serving more than one story and shall be located in a serviceable area downstream of the last duct inlet.
4. Each connection to a vertical duct or riser serving two or more stories from return ducts or plenums of heating, ventilating and air-conditioning systems, except that in Group R occupancies, an approved smoke detector may be used in each return air riser carrying not more than 5,000 cubic feet per minute (cfm) and serving not more than 10 air inlet openings.

The actuation of any detector required by this Section shall operate a voice alarm system and shall place into operation all equipment necessary to prevent the recirculation of smoke.

718.8 Alarm and communication systems. Three communication systems shall be provided as follows:

(a) **Voice alarm system.**

1. The operation of any smoke detector, sprinkler, water flow device or manual fire alarm system, required by this Section, shall automatically activate a voice alarm system. The voice alarm system shall provide a predetermined message on a selective basis to the area where the alarm originated.
2. The voice alarm shall provide information and give direction to the occupants.
3. The central control station shall contain controls for the voice alarm system so that selective or general voice alarm may be manually initiated.
4. The system shall be electronically supervised continuously against component failure of the audiopath, including amplifiers, speaker wiring, switches and electrical contacts, and shall detect opens and shorts that might impair the function of the system.
5. Activation of the system shall automatically sound an alert signal to the desired areas followed by the voice instructions giving appropriate information.
6. The acceptable level is 15 decibels above the ambient sound level measured 5 feet above the floor in the occupied area.

7. The alarm shall be designed to be heard clearly by all occupants within the building or designated portions thereof as is required for the public address system.

8. Visual and audible alarms shall be installed and so located as to be heard or seen by all occupants in every occupied space within the building. Visual alarms are required in hallways, lobbies, restrooms, and any other general usage and common use areas. (See the *EPCOT Accessibility Code for Building Construction* for additional requirements.)

(b) **Public address system.** A public address communication system designed to be clearly heard by all occupants of the building shall operate from the central control station. It shall be established on a selective or general basis to the following terminal areas:

1. Elevators.
2. Elevator lobbies.
3. Corridors.
4. Exit stairways.
5. Rooms and tenant spaces exceeding 1,000 square feet in area.
6. Dwelling units in apartment houses.
7. Hotel guest rooms or suites.

(c) **Fire Department communication system.**

1. A two-way fire department communication system shall be provided for fire department use. It shall operate between the central control station and every elevator, elevator lobby, entry to enclosed exit stairway and in corridors. The fire department communications system shall be connected to an approved emergency service, which operates continuously.
2. The alarm and communications systems shall be designed and installed such that damage to any terminal unit or speaker will not render more than one zone of the system inoperative.
3. The voice alarm and public address system may be a combined system. When approved, the fire department communications system may be combined with the voice alarm system and the public address system.

718.9 Central control station. A central control station for fire department operations shall be provided in a location approved by the fire department. It shall contain:

- (a) The voice alarm and public address system panels.
- (b) The fire department communications panel.
- (c) Fire detection and alarm system annunciator panels and firefighter smoke control panel.
- (d) Status indicators showing location of elevators in the hoistways.
- (e) Status indicators and controls for air-handling systems.
- (f) Sprinkler valve and water-flow-detector display panels.

- (g) Emergency power, light and emergency system controls and status indicators.
- (h) A telephone for fire department use with controlled access to the public telephone system.
- (i) Controls for simultaneously unlocking all locked stairway doors.
- (j) The Central Control Station shall be separated from the building by 1-hour fire resistance rated construction.

718.10 Smoke control. Mechanical ventilation for the removal of products of combustion shall be provided in every story and shall consist of one of the following:

- (a) The mechanical air-handling equipment shall be designed to accomplish smoke removal. Under fire conditions, the return and exhaust air shall be moved directly to the outside without recirculation to other sections of the building. The supply fans shall provide 100 percent outside air. The area involved shall have a minimum of one air change every 10 minutes to meet this requirement.
- (b) A zone-based active smoke control system shall be provided in accordance with Section 720.
- (c) Any other approved design that will produce equivalent results and is acceptable to the Building Official.

718.11 Fire alarm notification zones. Each floor shall be zoned separately. If the floor area exceeds 22,500 square feet, additional zoning shall be provided. The length of any zone shall not exceed 200 feet in any direction. Zoning indicator panels and controls shall be located as approved by the Fire Department. Annunciators shall lock in until the system is reset.

718.12 Standby power. A standby power system complying with the *EPCOT Electrical Code* shall be provided for standby power loads specified in Subsection 718.12.2.

718.12.1 Special requirements for standby power systems. If the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both. System supervision with manual start and transfer features shall be provided at the fire command center.

718.12.2 Standby power loads. The following are classified as standby power loads:

- 1. Power and lighting for the fire command center required by Subsection 718.8.
- 2. Standby power shall be provided for elevators in accordance with EPCOT Standard 5-1.
- 3. Jockey pumps and compressors for dry pipe and pre-action automatic sprinkler systems.

718.13 Emergency power systems. An emergency power system complying with the *EPCOT Electrical Code* shall be

provided for emergency power loads specified in Subsection 718.13.1.

718.13.1 Emergency power loads. The following are classified as emergency power loads.

- 1. Exit signs and means of egress illumination required by the *EPCOT Building Code*.
- 2. Elevator car lighting.
- 3. Ventilation and automatic fire detection equipment for smokeproof enclosures.
- 4. Smoke control systems.
- 5. Emergency voice/alarm communications systems.
- 6. Automatic fire detection systems.
- 7. Fire alarm systems.
- 8. Electrically powered fire pumps.

718.14 Means of egress and evacuation. The means of egress in high-rise buildings shall comply with Subsections 718.14.1 through 718.14.5.

718.14.1 Remoteness of exit stairway enclosures. The required exit stairway enclosures shall be separated by a distance not less than 30 feet or not less than one-fourth of the length of the maximum overall diagonal dimension of the building or area to be served, whichever is less. The distance shall be measured in a straight line between the nearest points of the exit stairway enclosures. In buildings with three or more exit stairway enclosures, at least two of the exit stairway enclosures shall comply with this Section. Interlocking or scissor stairs shall be counted as one exit stairway.

718.14.2 Additional exit stairway. For buildings other than Group R that are more than 420 feet in building height, one additional exit stairway meeting the requirements of Sections 806 and 809 shall be provided in addition to the minimum number of exits required by Subsection 803.1. The total width of any combination of remaining exit stairways with one exit stairway removed shall not be less than the total width required by Subsection 803.2. Scissor stairs shall not be considered the additional exit stairway required by this Section.

718.14.3 Stairway door operation. Stairway doors other than the exit discharge doors shall be permitted to be locked from the stairway side. Stairway doors that are locked from the stairway side shall be capable of being unlocked simultaneously without unlatching upon a signal from the fire command center.

718.14.3.1 Stairway communication system. A telephone or other two-way communications system connected to an approved constantly attended station shall be provided at not less than every fifth floor in each stairway where the doors to the stairway are locked.

718.14.4 Smokeproof exit enclosures. Every required level exit stairway serving floors more than 75 feet above the lowest level of fire department vehicle access shall comply with Subsection 720.20.

718.14.5 Luminous egress path markings. Luminous egress path markings shall be installed in accordance with Subsection 718.14.5.1 through 718.14.5.11.

718.14.5.1 Exit stair treads. Exit stair treads shall incorporate a marking stripe that is applied as a paint/coating or be a material that is integral with the nosing of each step. The marking stripe shall be installed along the horizontal leading edge of the step and shall extend the full width of the step. The marking stripe shall also meet the following requirements:

1. The marking stripe shall be not more than $\frac{1}{2}$ inch from the leading edge of each step and shall not overlap the leading edge of the step by more than $\frac{1}{2}$ inch down the vertical face of the step.
2. The marking stripe shall have a minimum horizontal width of 1 inch and a maximum width of 2 inches.
3. The dimensions and placement of the marking stripe shall be uniform and consistent on each step throughout the exit enclosure.
4. Surface-applied marking stripes using adhesive-backed tapes shall not be used.

718.14.5.2 Exit stair landings. The leading edge of exit stair landings shall be marked with a solid and continuous marking stripe consistent with the dimensional requirements for stair treads and shall be the same length as, and consistent with, the stripes on the steps.

718.14.5.3 Exit stair handrails. All handrails and handrail extensions shall be marked with a solid and continuous marking stripe and meet the following requirements:

1. The marking stripe shall be applied to the upper surface of the handrail or be a material integral with the upper surface of the handrail for the entire length of the handrail, including extensions.
2. The marking stripe shall have a minimum horizontal width of 1 inch.
3. The dimensions and placement of the marking stripe shall be uniform and consistent on each handrail throughout the exit enclosure.

718.14.5.4 Perimeter demarcation marking. Stair landings, exit passageways, and other parts of the floor areas within the exit enclosure shall be provided with a solid and continuous perimeter demarcation marking stripe on the floor. The marking stripe shall also meet the following requirements:

1. The marking stripe shall have a minimum horizontal width of 1 inch and a maximum width of 2 inches, with interruptions not exceeding 4 inches.
2. The marking stripe shall be applied within 2 inches of the wall.
3. The marking stripe shall continue in front of all door openings swinging into the exit enclosure. However, the marking stripe shall not be applied

in front of door openings discharging from the exit enclosure.

4. The dimensions and placement of the perimeter demarcation marking stripe shall be uniform and consistent throughout the exit enclosure.
5. Surface-applied marking stripes using adhesive-backed tapes shall not be used.

718.14.5.5 Obstacles. Obstacles that are in the exit enclosure at or below $6\frac{1}{2}$ feet in height, and that project more than 4 inches into the egress path, shall be identified with markings not less than 1 inch in horizontal width comprised of a pattern of alternating equal bands of luminescent material and black; and with the alternating bands not more than 2 inches in horizontal width and angled at 45 degrees.

718.14.5.6 Doors serving exit enclosure. All doors serving the exit enclosure that swing out from the enclosure in the direction of egress travel shall be provided with a marking stripe on the top and sides of the door(s) frame(s). The marking stripe shall also meet the following requirements:

1. The marking stripe shall have a minimum horizontal width of 1 inch and a maximum width of 2 inches.
2. Gaps shall be permitted in the continuity of door frame markings where a line is fitted into a corner or bend, but shall be as small as practicable, and in no case shall gaps be greater than 1 inch.
3. Where the door molding does not provide enough flat surface on which to locate the marking stripe, the marking stripe shall be located on the wall surrounding the frame.
4. The dimensions and placement of the marking stripe shall be uniform and consistent on all doors in the exit enclosure.

718.14.5.7 Door hardware marking. The door hardware for the doors serving the exit enclosure that swing out from the enclosure in the direction of egress travel shall be provided with a marking stripe.

The marking stripe shall also meet the following requirements:

1. The door hardware necessary to release the latch shall be outlined with a marking stripe having a minimum horizontal width of 1 inch.
2. Where panic hardware is installed, the following criteria shall be met:
 - (a) The marking stripe shall have a minimum horizontal width of 1 inch and be applied to the entire length of the actuating bar or touch pad.
 - (b) The placement of the marking stripe shall not interfere with the viewing of any instructions on the actuating bar or touch pad.

718.14.5.8 Emergency exit symbol. An emergency exit symbol with a luminescent background shall be applied on all doors serving the exit enclosure that swing out from the enclosure in the direction of egress travel. The emergency exit symbol shall also meet the following requirements:

1. The emergency exit symbol shall meet the requirements of NFPA 170, *Standard for Fire Safety and Emergency Symbols*.
2. The emergency exit symbol applied on the door shall be not higher than 18 inches above the finished floor.

718.14.5.9 Uniformity. Placement and dimensions of the marking stripes shall be consistent and uniform throughout the same exit enclosure.

718.14.5.10 Materials. Exit stair path markings shall be made of any material, including paint, provided that an electrical charge is not required to maintain the required luminescence. Such materials shall include, but shall not be limited to, self-luminous materials and photo luminescent materials. Materials shall comply with one of the following:

1. ASTM E2073, *Standard Test Method for Photopic Luminance of Photo luminescent (Phosphorescent) Markings*, except that the charging source shall be 1 footcandle of fluorescent illumination for 60 minutes, and the minimum luminance shall be 5 millicandelas per square meter after 90 minutes.
2. UL 1994, *Standard for Luminous Egress Path Marking Systems*.
3. An alternate standard deemed equivalent and approved by the Building Official.

718.14.5.11 Exit stair illumination. Exit enclosures where photo luminescent materials are installed shall be continuously illuminated for at least 60 minutes prior to periods when the building is occupied. Lighting control devices that automatically turn exit enclosure lighting on and off, based on occupancy, shall not be installed.

718.15 Elevators. Elevator installation and operation in high-rise buildings shall comply with EPCOT Standard 5-1 and Subsections 718.14.1 and 718.14.2.

718.15.1 Fire service access elevator. In buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access, a minimum of two fire service access elevators shall be provided in accordance with EPCOT Standard 5-1. Each fire service elevator shall have a capacity of not less than 3,500 pounds.

718.15.2 Occupant evacuation elevators. Reserved.

718.16 Acceptance tests. Upon completion of a fire alarm system, the installation shall be subjected to a performance test to demonstrate its efficiency of operation.

SECTION 719 ATRIUMS

719.1 General. Vertical openings through two or more floor levels may be unenclosed in all buildings other than Group H occupancies when meeting the requirements of this Section. Stair enclosures, utility chases, elevator hoistways and escalators shall not be classified as an atrium.

719.2 Use. The floor of the atrium shall not be used for other than low fire hazard uses and only approved materials and decorations may be used in the atrium space.

719.3 Automatic sprinkler protection. An approved automatic sprinkler system shall be installed throughout the entire building.

When the ceiling of the atrium is more than 55 feet above the floor, sprinkler protection at the ceiling of the atrium may be omitted when approved by the Building Official.

719.4 Smoke control. A smoke control system, complying with Section 720, shall be designed to control the migration of products of combustion in the atrium space.

Exception: Smoke control is not required for atriums that connect only two stories.

719.5 Enclosure of atriums. Atrium spaces shall be separated from adjacent spaces by 1-hour fire-resistive construction.

Exceptions:

1. A glass wall forming a smoke partition where automatic sprinklers are spaced 6 feet or less along both sides of the separation wall, or on the room side only if there is not a walkway on the atrium side, and between 4 inches and 12 inches away from the glass and designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction. The glass shall be installed in a gasketed frame so that the framing system deflects without breaking (loading) the glass before the sprinkler system operates. Where glass doors are provided in the glass wall, they shall be either self-closing or automatic-closing.
2. A glass-block wall assembly in accordance with EPCOT Standard 1006-2.301.6 and having a $3/4$ -hour fire protection rating.
3. The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium where such spaces are accounted for in the design of the smoke control system.

719.6 Smoke detectors. In addition to such smoke detection as may be required by the *EPCOT Mechanical Code*, smoke detectors shall be provided at the ceiling of the atrium and on the underside edge of portion of the floor area projecting into the atrium space. Detectors shall be located in accordance with their listing. The actuation of any one detector shall cause an alarm to be sounded at a constantly manned location.

719.7 Standby power. All equipment required to provide smoke control shall be connected to a standby power system.

719.8 Smoke control in other than the atrium. When the building containing an atrium is provided with an air-conditioning system, that system shall be so designated as to exhaust smoke from the occupied space as would be required for a high-rise building and shall operate without interruption.

719.9 Acceptance of smoke control system. Before the Certificate of Occupancy is issued, the smoke control system shall be tested by the Department of Building and Safety and the Fire Service to show compliance with the requirements of this Section.

719.10 Inspections. The smoke removal and control systems shall be tested annually by the Department of Building and Safety and the Fire Service, and such inspections shall have a log of the tests and shall be kept by the inspection agency.

719.11 Interior finish. The interior finish of walls and ceilings of the atrium shall not exceed Class II. (See Table 7.4.)

SECTION 720 SMOKE CONTROL SYSTEMS

720.1 Scope and purpose. This Section applies to mechanical or passive smoke control systems when they are required by other provisions of this Code. The purpose of this Section is to establish minimum requirements for the design, installation and acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are not intended for the preservation of contents, the timely restoration of operations or for assistance in fire suppression or overhaul activities. Smoke control systems regulated by this Section serve a different purpose than the smoke- and heat-venting provisions found in Section 716. Mechanical smoke control systems shall not be considered exhaust systems under the *EPCOT Mechanical Code*.

720.2 General design requirements. Buildings, structures or parts thereof required by this Code to have a smoke control system or systems shall have such systems designed in accordance with the applicable requirements of Section 720 and the generally accepted and well-established principles of engineering relevant to the design. The construction documents shall include sufficient information and detail to adequately describe the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied by sufficient information and analysis to demonstrate compliance with these provisions.

720.2.1 Smoke control in Group B and R high-rise buildings. The smoke control system shall prevent the migration of smoke from the floor or smoke zone of fire incidence to adjacent smoke zones and stories by pressure differential. The floor or zone of incident shall be exhausted to produce no less than a negative 0.05 inch water column with respect to the adjacent smoke zones and floors above and below.

Exception: Smoke zones on lower floor levels not used for sleeping may be protected by passive or other approved smoke control methods.

720.3 Special inspection and test requirements. In addition to the ordinary inspection and test requirements which buildings, structures and parts thereof are required to undergo, smoke control systems subject to the provisions of Section 720 shall undergo special inspections and tests sufficient to verify the proper commissioning of the smoke control design in its final installed condition. The design submission accompanying the construction documents shall clearly detail procedures and methods to be used and the items subject to such inspections and tests. Such commissioning shall be in accordance with generally accepted engineering practice and, where possible, based on published standards for the particular testing involved. The special inspections and tests required by this Section shall be conducted under the same terms in Subsection 306.5.

720.4 Analysis. A rational analysis supporting the types of smoke control systems to be employed, their methods of operation, the systems supporting them and the methods of construction to be utilized shall accompany the submitted construction documents and shall include, but not be limited to, the items indicated in Subsections 720.4.1 through 720.4.6.

720.4.1 Stack effect. The system shall be designed such that the maximum probable normal or reverse stack effect will not adversely interfere with the system's capabilities. In determining the maximum probable stack effect, altitude, elevation, weather history and interior temperatures shall be used.

720.4.2 Temperature effect of fire. Buoyancy and expansion caused by the design fire in accordance with Subsection 720.9 shall be analyzed. The system shall be designed such that these effects do not adversely interfere with the system's capabilities.

720.4.3 Wind effect. The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of Chapter 9.

720.4.4 HVAC systems. The design shall consider the effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems status. The design shall consider the effects of the fire on the HVAC systems.

720.4.5 Climate. The design shall consider the effects of low temperatures on systems, property and occupants. Air inlets and exhausts shall be located so as to prevent snow or ice blockage.

720.4.6 Duration of operation. All portions of active or passive smoke control systems shall be capable of continued operation after detection of the fire event for a period of not less than either 20 minutes or 1.5 times the calculated egress time, whichever is greater.

720.5 Smoke barrier construction. Smoke barriers shall comply with Section 714 and shall be constructed and sealed to limit leakage areas exclusive of protected openings. The maximum allowable leakage area shall be the aggregate area calculated using the following leakage area ratios:

1. Walls: $A/A_w = 0.00100$

- 2. Exit enclosures: $A/A_w = 0.00035$
- 3. All other shafts: $A/A_w = 0.00150$
- 4. Floors and roofs: $A/A_F = 0.00050$

where:

A = Total leakage area, square feet.

A_F = Unit floor or roof area of barrier, square feet.

A_w = Unit wall area of barrier, square feet.

The leakage area ratios shown do not include openings due to doors, operable windows or similar gaps. These shall be included in calculating the total leakage area.

720.5.1 Leakage area. The total leakage area of the barrier is the product of the smoke barrier gross area multiplied by the allowable leakage area ratio, plus the area of other openings such as gaps and operable windows. Compliance shall be determined by achieving the minimum air pressure difference across the barrier with the system in the smoke control mode for mechanical smoke control systems. Passive smoke control systems tested using other approved means such as door fan testing shall be as approved by the Building Official.

720.5.2 Opening protection. Openings in smoke barriers shall be protected by automatic-closing devices actuated by the required controls for the mechanical smoke control system. Door openings shall be protected by fire door assemblies complying with Subsection 704.5.

Exceptions:

1. Passive smoke control systems with automatic-closing devices actuated by spot-type smoke detectors listed for releasing service installed in accordance with Section 1418 of the *EPCOT Fire Prevention Code*.
2. Fixed openings between smoke zones that are protected utilizing the airflow method.
3. In Group E-3, where such doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with fire protection-rated glazing materials in fire protection-rated frames, the area of which shall not exceed that tested. The doors shall be close-fitting within operational tolerances and shall not have undercuts, louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges and shall be automatic-closing by smoke detection in accordance with Subsection 704.3(d). Positive-latching devices are not required.
4. Group D-1.
5. Openings between smoke zones with clear ceiling heights of 14 feet or greater and bank-down capacity of greater than 20 minutes as determined by the design fire size.

720.5.2.1 Ducts and air transfer openings. Ducts and air transfer openings are required to be protected with a

minimum Class II, 250°F smoke damper complying with Subsection 609.3 of the *EPCOT Mechanical Code*.

720.6 Pressurization method. The primary mechanical means of controlling smoke shall be by pressure differences across smoke barriers. Maintenance of a tenable environment is not required in the smoke control zone of fire origin.

720.6.1 Minimum pressure difference. The minimum pressure difference across a smoke barrier shall be 0.05-inch water gage (in fully sprinklered buildings).

720.6.2 Maximum pressure difference. The maximum air pressure difference across a smoke barrier shall be determined by required door-opening or closing forces. The actual force required to open exit doors when the system is in the smoke control mode shall be in accordance with Subsection 804.2(c). Opening and closing forces for other doors shall be determined by standard engineering methods for the resolution of forces and reactions. The calculated force to set a side-hinged, swinging door in motion shall be determined by:

$$F = F_{dc} + K(WA\Delta P)/2(W - d) \quad \text{(Equation 9-1)}$$

where:

A = Door area, square feet.

d = Distance from door handle to latch edge of door, feet.

F = Total door opening force, pounds.

F_{dc} = Force required to overcome closing device, pounds.

K = Coefficient 5.2.

W = Door width, feet.

ΔP = Design pressure difference, inches of water.

720.7 Airflow design method. When approved by the Building Official, smoke migration through openings fixed in a permanently open position, which are located between smoke control zones by the use of the airflow method, shall be permitted. The design airflow shall be in accordance with this Section. Airflow shall be directed to limit smoke migration from the fire zone. The geometry of openings shall be considered to prevent flow reversal from turbulent effects.

720.7.1 Velocity. The minimum average velocity through a fixed opening shall not be less than:

$$v = 217.2 [h (T_f - T_o)/(T_f + 460)]^{1/2} \quad \text{(Equation 9-2)}$$

$$\text{For SI: } v = 119.9 [h (T_f - T_o)/T_f]^{1/2}$$

where:

h = Height of opening, feet.

T_f = Temperature of smoke, °F.

T_o = Temperature of ambient air, °F.

v = Air velocity, feet per minute.

720.7.2 Prohibited conditions. This method shall not be employed where either the quantity of air or the velocity of the airflow will adversely affect other portions of the

smoke control system, unduly intensify the fire, disrupt plume dynamics or interfere with exiting. In no case shall airflow toward the fire exceed 200 feet per minute. Where the formula in Subsection 720.7.1 requires airflow to exceed this limit, the airflow method shall not be used.

720.8 Exhaust method. When approved by the Building Official, mechanical smoke control for large enclosed volumes, such as in atriums or malls, shall be permitted to utilize the exhaust method. Smoke control systems using the exhaust method shall be designed in accordance with NFPA 92B.

720.8.1 Smoke layer. The height of the lowest horizontal surface of the smoke layer interface shall be maintained at least 6 feet above any walking surface that forms a portion of a required egress system within the smoke zone.

720.9 Design fire. The design fire shall be based on a rational analysis performed by the registered design professional and approved by the Building Official. The design fire shall be based on the analysis in accordance with Subsection 720.4 and this Section.

720.9.1 Factors considered. The engineering analysis shall include the characteristics of the fuel, fuel load, effects included by the fire and whether the fire is likely to be steady or unsteady.

720.9.2 Separation distance. Determination of the design fire shall include consideration of the type of fuel, fuel spacing and configuration.

720.9.3 Heat-release assumptions. The analysis shall make use of best available data from approved sources and shall not be based on excessively stringent limitations of combustible material.

720.9.4 Sprinkler effectiveness assumptions. A documented engineering analysis shall be provided for conditions that assume fire growth is halted at the time of sprinkler activation.

720.10 Equipment. Equipment including, but not limited to, fans, ducts, automatic dampers and balance dampers, shall be suitable for its intended use, suitable for the probable exposure temperatures that the rational analysis indicates and as approved by the Fire Official.

720.10.1 Exhaust fans. Components of exhaust fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed. This temperature rise shall be computed by:

$$T_s = (Q_c/mc) + (T_a) \quad \text{(Equation 9-3)}$$

where:

c = Specific heat of smoke at smoke layer temperature, Btu/lb °F.

m = Exhaust rate, pounds per second.

Q_c = Convective heat output of fire, Btu/s.

T_a = Ambient temperature, °F.

T_s = Smoke temperature, °F.

Exception: Reduced T_s , as calculated based on the assurance of adequate dilution air.

720.10.2 Ducts. Duct materials and joints shall be capable of withstanding the probable temperatures and pressures to which they are exposed as determined in accordance with Subsection 720.10.1. Ducts shall be constructed and supported in accordance with the *EPCOT Mechanical Code*. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5 percent of design flow. Results of such testing shall be a part of the documentation procedure. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports.

Exception: Flexible connections (for the purpose of vibration isolation) complying with the *EPCOT Mechanical Code*, that are constructed of approved fire-resistance-rated materials.

720.10.3 Equipment, inlets and outlets. Equipment shall be located so as to not expose uninvolved portions of the building to an additional fire hazard. Outside air inlets shall be located so as to minimize the potential for introducing smoke or flame into the building. Exhaust outlets shall be so located as to minimize reintroduction of smoke into the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.

720.10.4 Automatic dampers. Automatic dampers, regardless of the purpose for which they are installed within the smoke control system, shall be listed and conform to the requirements of approved, recognized standards.

720.10.5 Fans. In addition to other requirements, belt-driven fans shall have 1.5 times the number of belts required for the design duty, with the minimum number of belts being two. Fans shall be selected for stable performance based on normal temperature and, where applicable, elevated temperature. Calculations and manufacturer's fan curves shall be part of the documentation procedures. Fans shall be supported and restrained by noncombustible devices in accordance with the requirements of Chapter 9. Motors driving fans shall not be operated beyond their nameplate horsepower (kilowatts), as determined from measurement of actual current draw, and shall have a minimum service factor of 1.15.

720.11 Power systems. The smoke control system shall be supplied with two sources of power. Primary power shall be from the normal building power systems. Secondary power shall be from an approved emergency source complying with the *EPCOT Electrical Code*. The emergency source and its transfer switches shall be separate from the normal power transformers and switch gears and, when installed inside the building, ventilated directly to and from the exterior. When installed inside a building, the emergency power source and transfer switch shall be installed in a room enclosed with not less than 2-hour fire-resistance-rated construction in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both. The transfer to full emergency power shall be automatic and within 10 seconds of failure of the primary power system.

720.11.1 Power sources and power surges. Elements of the smoke management system relying on volatile memories or the like shall be supplied with uninterruptable power sources of sufficient duration to span a 15-minute primary power interruption. Elements of the smoke management system susceptible to power surges shall be suitably protected by conditioners, suppressors or other approved means.

720.11.2 Variable frequency drives (VFD). VFD or similar devices used in conjunction with any smoke management system shall automatically default to the original settings established at which time the system was originally accepted. If a VFD or similar device is installed after a smoke management system has been tested and accepted, new system testing shall be required.

720.12 Detection and control systems. Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Section 1418 of the *EPCOT Fire Prevention Code*. Such systems shall be equipped with a control unit complying with UL 864 and listed as smoke control equipment.

720.12.1 Verification. Control systems for mechanical smoke control systems shall include provisions for verification. Verification shall include positive confirmation of actuation, testing, manual override and the presence of power downstream of all disconnects. A preprogrammed weekly test sequence shall report abnormal conditions audibly, visually and by printed report. The preprogrammed weekly test shall operate all devices, equipment and components used for smoke control.

Exception: Where verification of individual components tested through the preprogrammed weekly testing sequence will interfere with normal building operation and produce unwanted effects to normal building operation, such individual components are permitted to be bypassed from the preprogrammed weekly testing, where approved by the Building Official and in accordance with the following:

1. Presence of power downstream of all disconnects shall be verified weekly by a listed control unit when the operation of components is bypassed by the preprogrammed weekly test.
2. Where components of the smoke control system are bypassed by the preprogrammed weekly test required by this Section, such components shall be tested semi-annually. The system shall also be tested under standby power conditions.

720.12.2 Wiring. In addition to meeting requirements of the *EPCOT Electrical Code*, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.

720.12.3 Activation. Smoke control systems shall be activated in accordance with this Section.

720.12.3.1 Pressurization, airflow or exhaust method. Mechanical smoke control systems using the pressurization, airflow or exhaust method shall have completely automatic control.

720.12.3.2 Passive method. Passive smoke control systems actuated by approved spot-type detectors listed for releasing service shall be permitted.

720.12.4 Automatic control. Where completely automatic control is required or used, the automatic-control sequences shall be initiated from an appropriately zoned automatic sprinkler system complying with Section 715, manual controls that are readily accessible to the fire department and any smoke detectors required by engineering analysis.

720.13 Control air tubing. Control air tubing shall be of sufficient size to meet the required response times. Tubing shall be flushed clean and dry prior to final connections and shall be adequately supported and protected from damage. Tubing passing through concrete or masonry shall be sleeved and protected from abrasion and electrolytic action.

720.13.1 Materials. Control-air tubing shall be hard-drawn copper, Type L, ACR in accordance with ASTM B42, ASTM B43, ASTM B68, ASTM B88, ASTM B251 and ASTM B280. Fittings shall be wrought copper or brass, solder type in accordance with ASME B16.18 or ASME B16.22. Changes in direction shall be made with appropriate tool bends. Brass compression-type fittings shall be used at final connection to devices; other joints shall be brazed using a BCuP5 brazing alloy with solidus above 1,100°F and liquids below 1,500°F. Brazing flux shall be used on copper-to-brass joints only.

Exception: Nonmetallic tubing used within control panels and at the final connection to devices, provided all of the following conditions are met:

1. Tubing shall be listed by an approved agency for flame and smoke characteristics.
2. Tubing and connected devices shall be completely enclosed within a galvanized or paint-grade steel enclosure having a minimum thickness of 0.0296 inch (No. 22 gage). Entry to the enclosure shall be by copper tubing with a protective grommet of neoprene or Teflon or by suitable brass compression to male barbed adapter.
3. Tubing shall be identified by appropriately documented coding.
4. Tubing shall be neatly tied and supported within the enclosure. Tubing bridging cabinets and doors or moveable devices shall be of sufficient length to avoid tension and excessive stress. Tubing shall be protected against abrasion. Tubing serving devices on doors shall be fastened along hinges.

720.13.2 Isolation from other functions. Control tubing serving other than smoke control functions shall be isolated by automatic isolation valves or shall be an independent system.

720.13.3 Testing. Control air tubing shall be tested at three times the operating pressure for not less than 30 minutes without any noticeable loss in gauge pressure prior to final connection to devices.

720.14 Marking and identification. The detection and control systems shall be clearly marked at all junctions, accesses and terminations.

720.15 Control diagrams. Identical control diagrams showing all devices in the system and identifying their location and function shall be maintained current and kept on file with the Building Official and the Fire Official, and at the fire alarm control panel or the fire command center, in a format and manner approved by the Fire Official.

720.16 Fire-fighter's smoke control panel. A fire-fighter's smoke control panel for fire department emergency response purposes only shall be provided and shall include manual control or override of automatic control for mechanical smoke control systems. The panel shall be located in a fire command center complying with Section 718 in high-rise buildings or buildings with smoke-protected assembly seating. In all other buildings, the fire-fighter's smoke control panel shall be installed in an approved location adjacent to the fire alarm control panel. The fire-fighter's smoke control panel shall comply with Subsections 720.16.1 through 720.16.3.

720.16.1 Smoke control systems. Fans within the building shall be shown on the fire-fighter's control panel. A clear indication of the direction of airflow and the relationship of components shall be displayed. Status indicators shall be provided for all smoke control equipment, annunciated by fan and zone, and by pilot-lamp-type indicators as follows:

1. Fans, dampers and other operating equipment in their normal status—WHITE.
2. Fans, dampers and other operating equipment in their off or closed status—RED.
3. Fans, dampers and other operating equipment in their on or open status—GREEN.
4. Fans, dampers and other operating equipment in a fault status—YELLOW/AMBER.

720.16.2 Smoke control panel. The fire-fighter's control panel shall provide control capability over the complete smoke-control system equipment within the building as follows:

1. ON-AUTO-OFF control over each individual piece of operating smoke control equipment that can also be controlled from other sources within the building. This includes stairway pressurization fans; smoke exhaust fans; supply, return and exhaust fans; elevator shaft fans and other operating equipment used or intended for smoke control purposes.
2. OPEN-AUTO-CLOSE control over individual dampers relating to smoke control and that are also controlled from other sources within the building.
3. ON-OFF or OPEN-CLOSE control over smoke control and other critical equipment associated with a fire or smoke emergency and that can only be controlled from the fire-fighter's control panel.

Exceptions:

1. Complex systems, where approved, where the controls and indicators are combined to control

and indicate all elements of a single smoke zone as a unit.

2. Complex systems, where approved, where the control is accomplished by computer interface using approved, plain English commands.

720.16.3 Control action and priorities. The fire-fighter's control panel actions shall be as follows:

1. ON-OFF and OPEN-CLOSE control actions shall have the highest priority of any control point within the building. Once issued from the fire-fighter's control panel, no automatic or manual control from any other control point within the building shall contradict the control action. Where automatic means are provided to interrupt normal, nonemergency equipment operation or produce a specific result to safeguard the building or equipment (i.e., duct freezestats, duct smoke detectors, high-temperature cutouts, temperature-actuated linkage and similar devices), such means shall be capable of being overridden by the fire-fighter's control panel. The last control action, as indicated by each fire-fighter's control panel switch position, shall prevail. In no case shall control actions require the smoke control system to assume more than one configuration at any one time.

Exception: Power disconnects required by the *EPCOT Electrical Code*.

2. Only the AUTO position of each three-position fire-fighter's control panel switch shall allow automatic or manual control action from other control points within the building. The AUTO position shall be the NORMAL, nonemergency, building control position. Where a fire-fighter's control panel is in the AUTO position, the actual status of the device (on, off, open, closed) shall continue to be indicated by the status indicator described above. When directed by an automatic signal to assume an emergency condition, the NORMAL position shall become the emergency condition for that device or group of devices within the zone. In no case shall control actions require the smoke control system to assume more than one configuration at any one time.

720.17 System response time. Smoke-control system activation shall be initiated immediately after receipt of an appropriate automatic or manual activation command. Smoke control systems shall activate individual components (such as dampers and fans) in the sequence necessary to prevent physical damage to the fans, dampers, ducts and other equipment. For purposes of smoke control, the fire-fighter's control panel response time shall be the same for automatic or manual smoke control action initiated from any other building control point. The total response time, including that necessary for detection, shutdown of operating equipment and smoke control system startup, shall allow for full operational mode to be achieved before the conditions in the space exceed the design smoke condition. The system response time for each component and their sequential relationships shall be detailed in the required rational analysis and verification of their installed condition reported in the required final report.

720.18 Acceptance testing. Devices, equipment, components and sequences shall be individually tested. These tests, in addition to those required by other provisions of this Code, shall consist of determination of function, sequence and, where applicable, capacity of their installed condition.

720.18.1 Detection devices. Smoke or fire detectors that are a part of a smoke control system shall be tested in accordance with NFPA 72 in their installed condition. When applicable, this testing shall include verification of airflow in both minimum and maximum conditions.

720.18.2 Ducts. Ducts that are part of a smoke control system shall be traversed using generally accepted practices to determine actual air quantities.

720.18.3 Dampers. Dampers shall be tested for function in their installed condition.

720.18.4 Inlets and outlets. Inlets and outlets shall be read using generally accepted practices to determine air quantities.

720.18.5 Fans. Fans shall be examined for correct rotation. Measurements of voltage, amperage, revolutions per minute and belt tension shall be made.

720.18.6 Smoke barriers. Measurements using inclined manometers or other approved calibrated measuring devices shall be made of the pressure differences across smoke barriers. Such measurements shall be conducted for each possible smoke control condition.

720.18.7 Controls. Each smoke zone equipped with an automatic-initiation device shall be put into operation by the actuation of one such device. Each additional device within the zone shall be verified to cause the same sequence without requiring the operation of fan motors in order to prevent damage. Control sequences shall be verified throughout the system, including verification of override from the fire-fighter's control panel and simulation of standby power conditions.

720.18.8 Special inspections for smoke control. Smoke control systems shall be tested by a special inspector.

720.18.8.1 Scope of testing. Special inspections shall be conducted in accordance with the following:

1. During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.
2. Prior to occupancy and after sufficient completion for the purposes of pressure-difference testing, flow measurements, and detection and control verification.

720.18.8.2 Qualifications. Special inspection agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers.

720.18.8.3 Reports. A complete report of testing shall be prepared by the special inspector or special inspection agency. The report shall include identification of all devices by manufacturer, nameplate data, design values, measured values and identification tag or mark. The report shall be reviewed by the responsible regis-

tered design professional and, when satisfied that the design intent has been achieved, the responsible registered design professional shall seal, sign and date the report.

720.18.8.3.1 Report filing. A copy of the final report shall be filed with the Building Official and an identical copy shall be maintained in an approved location at the building.

720.18.9 Identification and documentation. Charts, drawings and other documents identifying and locating each component of the smoke control system, and describing its proper function and maintenance requirements, shall be maintained on file at the building as an attachment to the report required by Subsection 720.18.8.3. Devices shall have an approved identifying tag or mark on them consistent with the other required documentation and shall be dated indicating the last time they were successfully tested and by whom.

720.19 System acceptance. Buildings, or portions thereof, required by this Code to comply with this Section shall not be issued a Certificate of Occupancy until such time that the Building Official determines that the provisions of this Section have been fully complied with and that the fire department has received satisfactory instruction on the operation, both automatic and manual, of the system.

Exception: In buildings of phased construction, a Temporary Certificate of Occupancy, as approved by the Fire Official, shall be allowed provided that those portions of the building to be occupied meet the requirements of this Section and that the remainder does not pose a significant hazard to the safety of the proposed occupants or adjacent buildings.

720.20 Smokeproof enclosures. Where required by Section 810, a smokeproof enclosure shall be constructed in accordance with this Section. A smokeproof enclosure shall consist of an enclosed interior exit stairway that conforms to Section 809 and an open exterior balcony or ventilated vestibule meeting the requirements of this Section. Where access to the roof is required by Subsection 806.13 walls, such access shall be from the smokeproof enclosure where a smokeproof enclosure is required.

720.20.1 Access. Access to the stair shall be by way of a vestibule or an open exterior balcony. The minimum dimension of the vestibule shall not be less than the required width of the corridor leading to the vestibule, but shall not have a width of less than 44 inches and shall not have a length of less than 72 inches in the direction of egress travel.

720.20.2 Construction. The smokeproof enclosure shall be separated from the remainder of the building by not less than 2-hour fire walls constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both. Openings are not permitted other than the required means of egress doors. The vestibule shall be separated from the stairway by not less than 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both. The open exterior

balcony shall be constructed in accordance with the fire-resistance-rating requirements for floor assemblies.

720.20.2.1 Door closers. Doors in a smokeproof enclosure shall be self- or automatic closing by actuation of a smoke detector in accordance with Section 704 and shall be installed at the floor-side entrance to the smokeproof enclosure. The actuation of the smoke detector on any door shall activate the closing devices on all doors in the smokeproof enclosure at all levels. Smoke detectors shall be installed in accordance with the *EPCOT Fire Prevention Code*.

720.20.3 Natural ventilation alternative. The provisions of Subsections 720.20.3.1 through 720.20.3.3 shall apply to ventilation of smokeproof enclosures by natural means.

720.20.3.1 Balcony doors. Where access to the stairway is by way of an open exterior balcony, the door assembly into the enclosure shall be a fire door assembly in accordance with Section 704.

720.20.3.2 Vestibule doors. Where access to the stairway is by way of a vestibule, the door assembly into the vestibule shall be a fire door assembly complying with Section 704. The door assembly from the vestibule to the stairway shall have not less than a 20-minute fire-resistance rating complying with Section 704.

720.20.3.3 Vestibule ventilation. Each vestibule shall have a minimum net area of 16 square feet of opening in a wall facing an outer court, yard or public way that is at least 20 feet in width.

720.20.4 Mechanical ventilation alternative. The provisions of Subsections 720.20.4.1 through 720.20.4.4 shall apply to ventilation of smokeproof enclosures by mechanical means.

720.20.4.1 Vestibule doors. The door assembly from the building into the vestibule shall be a fire door assembly complying with Subsection 805.8. The door assembly from the vestibule to the stairway shall not have less than a 20-minute fire-resistance rating and meet the requirements for a smoke door assembly in accordance with Subsection 805.8. The door shall be installed in accordance with NFPA 105.

720.20.4.2 Vestibule ventilation. The vestibule shall be supplied with not less than one air change per minute and the exhaust shall not be less than 150 percent of supply. Supply air shall enter and exhaust air shall discharge from the vestibule through separate, tightly constructed ducts used only for that purpose. Supply air shall enter the vestibule within 6 inches of the floor level. The top of the exhaust register shall be located at the top of the smoke trap but not more than 6 inches down from the top of the trap, and shall be entirely within the smoke trap area. Doors in the open position shall not obstruct duct openings. Duct openings with controlling dampers are permitted where necessary to meet the design requirements, but dampers are not otherwise required.

720.20.4.2.1 Engineered ventilation system. Where a specially engineered system is used, the system shall exhaust a quantity of air equal to not

less than 90 air changes per hour from any vestibule in the emergency operation mode and shall be sized to handle three vestibules simultaneously. Smoke detectors shall be located at the floor-side entrance to each vestibule and shall activate the system for the affected vestibule. Smoke detectors shall be installed in accordance with the *EPCOT Fire Prevention Code*.

720.20.4.3 Smoke trap. The vestibule ceiling shall be at least 20 inches higher than the door opening into the vestibule to serve as a smoke and heat trap and to provide an upward-moving air column. The height shall not be decreased unless approved and justified by design and test.

720.20.4.4 Stair shaft air movement system. The stair shaft shall be provided with a dampered relief opening and supplied with sufficient air to maintain a minimum positive pressure of 0.10 inch of water in the shaft, relative to the vestibule, with all doors closed.

720.20.5 Stair pressurization alternative. Where the building is equipped throughout with an automatic sprinkler system in accordance with Subsection 715.4, the vestibule is not required, provided that interior exit stairways are pressurized to a minimum of 0.05 inch of water and a maximum of 0.35 inch of water in the shaft relative to the building measured with all stairway doors closed under maximum anticipated stack effect and wind effect.

720.20.6 Ventilating equipment. The activation of ventilating equipment required by the alternatives in Subsections 720.20.4 and 720.20.5 shall be by smoke detectors installed at each floor level at an approved location at the entrance to the smokeproof enclosure. When the closing device for the stair shaft and vestibule doors is activated by smoke detection or power failure, the mechanical equipment shall activate and operate at the required performance levels. Smoke detectors shall be installed in accordance with the *EPCOT Fire Prevention Code*.

720.20.6.1 Ventilation systems. Smokeproof enclosure ventilation systems shall be independent of other building ventilation systems. The equipment, control wiring, power wiring and ductwork shall comply with one of the following:

1. Equipment, control wiring, power wiring and ductwork shall be located exterior to the building and directly connected to the smokeproof enclosure or connected to the smokeproof enclosure by ductwork enclosed by not less than 2-hour fire walls constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both.
2. Equipment, control wiring, power wiring and ductwork shall be located within the smokeproof enclosure with intake or exhaust directly from and to the outside or through ductwork enclosed by not less than 2-hour fire walls constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both.

3. Equipment, control wiring, power wiring and ductwork shall be located within the building if separated from the remainder of the building, including other mechanical equipment, by not less than 2-hour fire walls constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both.

Exceptions:

1. Control wiring and power wiring utilizing a 2-hour fire-resistance-rated cable or cable system.
2. Where encased with not less than 2 inches of concrete.

720.20.6.2 Standby power. Mechanical vestibule and stair shaft ventilation systems and automatic fire detection systems shall be powered by an approved standby power system conforming to the *EPCOT Electrical Code*.

720.20.6.3 Acceptance and testing. Before the mechanical equipment is approved, the system shall be tested in the presence of the Building Official to confirm that the system is operating in compliance with these requirements.

720.21 Elevator hoistway pressurization alternative. Where elevator hoistway pressurization is provided in lieu of required enclosed elevator lobbies, the pressurization system shall comply with Subsections 720.21.1 through 720.21.11.

720.21.1 Pressurization requirements. Elevator hoistways shall be pressurized to maintain a minimum positive pressure of 0.10 inch of water and a maximum positive pressure of 0.25 inch of water with respect to adjacent occupied space on all floors. This pressure shall be measured at the midpoint of each hoistway door, with all elevator cars at the floor of recall and all hoistway doors on the floor of recall open and all other hoistway doors closed. The pressure differentials shall be measured between the hoistway and the adjacent elevator landing. The opening and closing of hoistway doors at each level must be demonstrated during this test. The supply air intake shall be from an outside, uncontaminated source located a minimum distance of 20 feet from any air exhaust system or outlet.

Exceptions:

1. On floors containing only Group R occupancies, the pressure differential is permitted to be measured between the hoistway and a dwelling unit or sleeping unit.
2. Where an elevator opens into a lobby enclosed in accordance with Subsection 5-1.401.2, the pressure differential is permitted to be measured between the hoistway and the space immediately outside the door(s) from the floor to the enclosed lobby.
3. The pressure differential is permitted to be measured relative to the outdoor atmosphere on floors other than the following:

3.1. The fire floor.

3.2. The two floors immediately below the fire floor.

3.3. The floor immediately above the fire floor.

4. The minimum positive pressure of 0.10 inch of water and a maximum positive pressure of 0.25 inch of water with respect to occupied floors are not required at the floor of recall with the doors open.

720.21.1.1 Use of ventilation systems. Ventilation systems, other than hoistway supply air systems, are permitted to be used to exhaust air from adjacent spaces on the fire floor, two floors immediately below and one floor immediately above the fire floor to the building's exterior where necessary to maintain positive pressure relationships as required in Subsection 720.21.1 during operation of the elevator shaft pressurization system.

720.21.2 Rational analysis. A rational analysis complying with Subsection 720.4 shall be submitted with the construction documents.

720.21.3 Ducts for system. Any duct system that is part of the pressurization system shall be protected with the same fire-resistance rating as required for the elevator shaft enclosure.

720.21.4 Fan system. The fan system provided for the pressurization system shall be as required by Subsections 720.21.4.1 through 720.21.4.4.

720.21.4.1 Fire resistance. Where located within the building, the fan system that provides the pressurization shall be protected with the same fire-resistance rating required for the elevator shaft enclosure.

720.21.4.2 Smoke detection. The fan system shall be equipped with a smoke detector that will automatically shut down the fan system when smoke is detected within the system.

720.21.4.3 Separate systems. A separate fan system shall be used for each elevator hoistway.

720.21.4.4 Fan capacity. The supply fan shall be either adjustable with a capacity of not less than 1,000 cfm per door, or that specified by a registered design professional to meet the requirements of a designed pressurization system.

720.21.5 Standby power. The pressurization system shall be provided with standby power in accordance with Section 2702.

720.21.6 Activation of pressurization system. The elevator pressurization system shall be activated upon activation of either the building fire alarm system or the elevator lobby smoke detectors. Where a building fire alarm system and elevator lobby smoke detectors are present, each shall be independently capable of activating the pressurization system.

720.21.7 Testing. Testing for performance shall be required in accordance with Subsection 720.18.8. System acceptance shall be in accordance with Subsection 720.19.

720.21.8 Marking and identification. Detection and control systems shall be marked in accordance with Subsection 720.14.

720.21.9 Control diagrams. Control diagrams shall be provided in accordance with Subsection 720.15.

720.21.10 Control panel. A control panel complying with Subsection 720.16 shall be provided.

720.21.11 System response time. Hoistway pressurization systems shall comply with the requirements for smoke control system response time in Subsection 720.17.

CHAPTER 8

MEANS OF EGRESS, OCCUPANT LOADS

SECTION 801 GENERAL REQUIREMENTS

801.1 Scope. The provisions of this Chapter establish minimum standards of egress and maximum occupant loads for the safety of the occupants of buildings and structures in the District.

801.2 Means of egress. Every building and structure, or part thereof, shall be provided with means of egress as required in this Chapter.

801.3 Maximum occupant loads. The maximum occupant loads established in this Chapter shall not be exceeded in any building or structure.

801.4 Definitions. For the purpose of this Code, terms used relating to a means-of-egress system shall be defined as follows:

- (a) **Egress court.** Yard or court that provides access to a public way for one or more exits.
- (b) **Exit passageway.** An exit component that is separated from all other interior spaces of a building or structure by fire-resistance-rated construction and opening protectives, and provides for a protected path of egress travel in a horizontal direction to the exit discharge or the public way.
- (c) **Exterior exit balcony.** A landing, veranda or porch, the long side of which is at least 50 percent open, projecting from the building and serving as a required exit. The open area above the guardrail shall be constructed to prevent the accumulation of smoke and toxic gases.
- (d) **Horizontal exit.** A way of passage from one building to an area of refuge in another building on approximately the same level, or a way of passage through or around a fire wall or fire partition to an area of refuge on approximately the same level in the same building. Either passage shall afford a calculated degree of safety from fire or smoke from the area of escape and areas communicating therewith.
- (e) **Means of egress.** A means of egress is a continuous and unobstructed path of vertical and horizontal egress travel from any occupied portion of a building or structure to a public way. A means of egress consists of three separate and distinct parts: the exit access, the exit and the exit discharge, defined as follows:

- 1. **Exit.** That part of a means-of-egress system that is separated from all other spaces of a building or structure by fire-resistant-rated construction and opening protectives as required to provide a protected path of egress travel between the exit access and the exit discharge. Exits include exterior exit doors at ground level, exit enclosures, exit passageways, exterior exit stairs, exterior exit ramps and horizontal exits.

- 2. **Exit access.** That part of a means-of-egress system leading from any occupied portion of a building or structure to an exit.
- 3. **Exit discharge.** That part of the means-of-egress system between the termination of an exit and a public way.
- (f) **Occupant load.** Total number of persons that may occupy a building or a part thereof.
- (g) **Panic hardware – paddle hardware.** A door-latching assembly incorporating a device that releases the latch upon the application of a force in the direction of exit.
- (h) **Public way.** A street, ally or other parcel of land open to the outside air leading to a street, which has a clear width and height of not less than 10 feet, used for the free passage of the public.
- (i) **Seating, continental.** Means of providing fixed seating in a Group A occupancy without having intervening aisles between the two side aisles. Spacing between rows of seats is wide enough to permit free passage of the audience, and all entrance doors are located in the sidewalls of the auditorium.
- (j) **Seating, modified-continental.** Means of providing fixed seating in a Group A occupancy as an alternative to standard or continental seating requirements. Spacing between rows of seats shall comply with requirements of continental seating. Entrance and exit doors are provided in sidewalls in addition to intervening aisles leading to rear or front exits.
- (k) **Stairway, private.** A stairway serving one tenant only. Such stairway need not be enclosed.

801.5 Changes in elevation. Except in Group R-3 occupancies, changes in elevation of less than 12 inches along any means of egress serving a tributary occupant load of 10 or more shall be by means of a ramp.

801.6 Means-of-egress continuity. The path of egress travel along a means of egress shall not be interrupted by any building element other than a means-of-egress component as specified in this Chapter. Obstructions shall not be placed in the required width of a means of egress, except as permitted by this Chapter. The required capacity of a means-of-egress system shall not be diminished along the path of egress travel.

SECTION 802 OCCUPANT LOADS

802.1 Occupant load permitted.

- (a) The occupant load permitted in a building or part thereof shall be computed at the rate of one occupant per unit of area as prescribed in Table 8.1.

Exceptions:

1. The occupant load of an area having fixed seats shall be determined by the provisions of Subsection 802.3. Aisles serving the fixed seats, not used for any other purpose, shall not be assumed to add to the occupant load.
2. When approved by the Building Official, the occupant load permitted in a building or part thereof may be increased above that specified in this Section if all other requirements of the EPCOT Codes are also met based on the modified number, and the occupant load shall not exceed one occupant per 5 square feet of occupiable floor space. An aisle or seating diagram may be required by the Building Official to substantiate an increase in occupant load. Where required by the Building Official, such diagram shall be posted.

- (b) When the square feet per occupant is not given for a specific occupancy in Table 8.1, the square feet per occupant shall be determined by the Building Official, and shall be based on the area given for the most nearly similar occupancy.
- (c) In determining the occupant load, all parts of a building shall be assumed to be occupied at the same time. Accessory areas normally used by the primary occupancy shall be provided with exits as though the accessory areas were completely occupied, but their occupant load need not be included in the total occupant load of the building.

802.2 Overcrowding. The number of occupants in a building or part thereof shall not exceed the capacity specified in Subsection 802.1, or as posted as required in Subsection 802.5.

802.3 Fixed seating. For areas having fixed seats and aisles, the occupant load shall be determined by the number of fixed seats installed therein. For areas having fixed seats without dividing arms, the occupant load shall be not less than the number of seats based on one person for each 18 inches of seating length. The occupant load of seating booths shall be based on one person for each 24 inches of booth seat length measured at the backrest of the seating booths.

802.4 Mixed occupancies.

- (a) The occupant load of a building housing mixed occupancies shall be determined by adding the number of occupants in the various occupancies set forth in Table 8.1.
- (b) Where a building contains two or more occupancies, the means-of-egress requirements shall apply to each portion of the building based on the occupancy of the space. Where two or more occupancies utilize portions of the same means-of-egress system, those egress components shall meet the more stringent requirements of all occupancies that are served.

802.5 Posting of room capacity. The capacity of a classroom, assembly room or similar room shall be posted in a conspicuous place near the main exit. Occupant load signs shall be approved by the Building Official and shall be maintained in legible condition by the owner of the building or by his authorized agent.

**SECTION 803
REQUIRED EXITS**

803.1 Number of means of egress.

- (a) Every building or story used for human occupancy shall have at least one means of egress, and shall have not less than two means of egress where required by Table 8.1.

All rooms and spaces within each story of a building used for human occupancy shall have at least one means of exit access, and shall have at least two means of exit access where required by Table 8.1.

- (b) In all occupancies, floors above the first story having an occupant load of more than 10 shall have access to not less than two independent exits for each tenant area.

Exception: Group R-3 occupancies may have one exit serving each tenant area within a single tenancy provided the unit is equipped with a smoke detection alarm device, does not exceed three stories or 35 feet in height, and the distance to an approved exit does not exceed 20 feet.

- (c) Each mezzanine used for other than storage, when more than 2,000 square feet in area or more than 60 feet in any dimension, shall have not less than two stairways to an adjacent floor.
- (d) For special exit requirements in Group A, B, D, E, H and R occupancies, see Sections 816 through 822.
- (e) Every story or part thereof having an occupant load of 500 to 999 shall have access to not less than three independent exits.
- (f) Every story or part thereof having an occupant load of 1,000 or more shall have access to not less than four independent exits.
- (g) The number of exits required from any story of a building shall be calculated by using the occupant load (see Table 8.1) of the story under consideration and adding percentages of the occupant loads of floors that exit through the level under consideration, as follows:

1. Fifty percent of the occupant load on the first adjacent story above and on the first adjacent story below when the story below exits through the floor under consideration.
2. Twenty-five percent of the occupant load on the story immediately above or below the first adjacent story.

- (h) The maximum number of exits required for any story and the maximum width required for any story shall be maintained until the exterior of the building is reached.
- (i) Basements or cellars, and occupied roofs, shall have means of egress as required for stories. Basements and cellars used for other than building service shall have not less than two means of egress.
- (j) Two exit access doorways are required in boiler, incinerator and furnace rooms where the area is over 500 square feet and any fuel-fired equipment exceeds 400,000 British thermal units (Btu) input capacity. Where two exit access doorways are required, one is permitted to be a fixed ladder or an alternating tread

device. Exit access doorways shall be separated by a horizontal distance equal to one-half the length of the maximum overall diagonal dimension of the room. (See Subsection 503.18.)

- (k) Where cellulose nitrate is handled in film laboratories, projection rooms and film processing rooms, two means of egress shall be provided. Doors shall be self-closing or automatic closing and shall have a 1-hour fire-resistive rating, not to exceed 100 square inches of wired glass set in steel frames.

TABLE 8.1
NUMBER OF EXITS AND SQUARE FEET PER OCCUPANT

USE	MINIMUM OF 2 MEANS OF EGRESS REQUIRED WHERE NUMBER OF OCCUPANTS IS OVER	AREA PER OCCUPANT ^b (square feet)
Aircraft hangars (no repair)	10	500 gross
Assembly areas Auditoriums Bowling lanes (assembly areas only) Churches and chapels Dance floors Lodge rooms	50	7 net
Assembly areas (less concentrated use) Banquet rooms Conference rooms Dining rooms Drinking establishments Exhibit rooms Gymnasiums Lounges Skating rinks Stages	50	15 net 10 net 15 net
Auction rooms	30	7 net
Children's homes and homes for aged	5	80 gross
Classrooms	50	20 net
Dormitories	10	50 net
Garages, parking	30	200 gross
Hospitals, sanitariums and nursing homes	5	80 gross
Hotels and apartments	10	200 gross
Library reading rooms	50	50 net
Locker rooms	30	50 net
Maintenance facilities	50	200 gross
Mechanical equipment rooms	30	300 gross
Nurseries for children (day care)	5	50 net
Offices	30	100 gross
Queue		4.5 net
Reviewing stands and Stadiums		[See 817.4(c)]
School shops and vocational rooms	50	50 net
Storage, stock, shipping areas	30	300 gross
Stores and retail salesrooms Basement ^a Ground floor Upper floors	50 10	30 gross 30 gross 60 gross

(continued)

TABLE 8.1—continued
NUMBER OF EXITS AND SQUARE FEET PER OCCUPANT

USE	MINIMUM OF 2 MEANS OF EGRESS REQUIRED WHERE NUMBER OF OCCUPANTS IS OVER	AREA PER OCCUPANT ^b (square feet)
Swimming pools ^c Water surface Deck	50 50	50 gross 30 gross
Warehouses	30	500 gross
All Others	50	100 gross

a. See Subsection 803.1(i) for exit requirements for basements, cellars and occupied roofs.

b. See Section 202 for definitions of area, gross and net floor.

c. Outdoor swimming pools enclosed within barriers shall be provided with exits as required by Section 803.

803.2 Means-of-egress width.

- The width (in feet) of any component of a means of egress shall be not less than the number of occupants served by that component divided by 50. Such width shall be divided approximately equally among the separate exits, except for specific requirements found in Section 816.
- The total width required for the exit from any story shall be determined by using the occupant load of that story, plus the percentages of the occupant loads of floors that exit through the level under consideration, as specified for number of exits in Subsection 803.1(g).
- When parts of a building are normally used at the same time, exits shall have the capacity to serve the total occupant load. When parts of a building are normally used at different times, exits shall have the capacity to serve the largest occupant load.

803.3 Arrangement of exits and exit access doorways.

- When only two exits or exit access doorways are required, they shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served, measured in a straight line between the exits or exit access doorways from nearest edge to nearest edge.

Exception: Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 715, the separation distance of the exits or exit access doorways shall not be less than one-third the length of the maximum overall diagonal dimension of the area served.

- Where three or more exits or exit access doorways are required, they shall be located so that at least two are placed a distance apart equal to that required in Subsection 803.3(a). The others shall be placed a reasonable distance apart.

803.4 Exit access travel distance. Exits shall be located so that the maximum length of exit access travel distance, measured from the most remote point within a story to the entrance to an exit along the natural and unobstructed path of egress travel, shall not exceed 200 feet. Where the path of exit access includes unenclosed stairways or ramps, the distance of travel on such means-of-egress components shall also be included in the travel distance measurement.

Exceptions:

1. Exit access travel distance in a Group B-1 occupancy shall not exceed a maximum 150 feet.
2. Exit access travel distance in an open parking garage shall not exceed 400 feet to a protected exit or an unprotected stair allowed in Subsection 818.3(b).
3. Exit access travel distance in a Group H-1 or H-2 occupancy shall not exceed 75 feet in accordance with Subsection 821.2(b).
4. Exit access travel distance in a temporary structure, such as a tent or membrane structure classified as an assembly occupancy, shall not exceed 150 feet.

803.5 Egress through adjoining or accessory areas.

- (a) Exit access from a room may be provided through an adjoining or intervening room or area when the adjoining room is accessory to the area served, is not a room or area of a high-hazard occupancy and provides a direct, discernible means of egress to an exit.
- (b) Foyers, lobbies and reception rooms constructed as for corridors shall not be construed as intervening rooms.
- (c) Egress is not permitted through any room that can be locked to prevent egress, service corridors, kitchens, closets, restrooms, store rooms or similar areas.
- (d) Where more than one tenant occupies any floor of a building or structure, each tenant space shall be provided with access to the required exits without passing through adjacent tenant spaces.

**SECTION 804
EXIT AND EXIT ACCESS DOORS**

804.1 Scope. The provisions of this Section shall apply to every exit and exit access door serving a means of egress having an occupant load of more than 10, or serving hazardous rooms or areas. The provisions of Subsections 804.3, 804.8 and 804.9 shall apply to all doors regardless of occupant load. Buildings or structures used for human occupancy shall have at least one exterior exit door that meets the requirements of Subsection 804.4.

804.2 Swing.

- (a) Doors shall swing in the direction of exit travel when serving an occupant load of 50 or more or when serving hazardous areas.
- (b) Sliding doors shall not be used as required exit or exit access doors.
- (c) Swinging doors shall not require more than 5 pounds of force for opening when the force is applied at the normal knob position when the door is unlatched.
- (d) Double-acting doors shall not be used in a means of egress serving a tributary occupant load of more than 100; nor shall they be used as a part of an opening protective, nor shall they be equipped with panic hardware. A double-acting door shall have a viewing panel of not less than 100 square inches.
- (e) Where required doors are operated by power that is activated by a photo-electric device, floor mat, wall

switches or other approved device, as well as doors with power-assisted manual operation, the design, installation and maintenance shall be such that, in the event of power failure, the door may be manually opened to permit exit travel. These doors shall be openable as is required for other nonpower-operable doors.

- (f) Power-operating sliding doors may be used provided the sliding leaf is equipped with an emergency swing (panic release) feature. The force to set the door into motion shall not exceed 50 pounds force.

A readily visible, durable sign in letters not less than 1 inch high on a contrasting background that reads as follows shall be located on the egress side of each door opening:

IN EMERGENCY, PUSH TO OPEN

804.3 Hardware.

- (a) Exit, exit access doors and gates required to serve as exit doors or exit access, shall be openable from the inside without the use of a key, tool or any special knowledge or effort. Manually operated flush bolts or surface bolts are prohibited. All hardware must be direct acting requiring no more than one operation. Double-cylinder dead bolts, requiring a key for operation on both sides, are prohibited on required means-of- egress doors unless the locking device is provided with a key that cannot be removed when the door is locked from the inside. A night latch, dead bolt or security device may be used on exit or exit access doors from a dwelling unit, hotel guest room or suite provided such devices are openable from the inside without the use of a key, tool, or any special knowledge or effort, and the device is mounted at a height not to exceed 48 inches above the finished floor. (See Section 814 for panic and fire exit hardware.)

Door handles, pulls, latches, locks and other operating devices on doors required to be accessible by the *EPCOT Accessibility Code for Building Construction* shall not require tight grasping, tight pinching or twisting of the wrist to operate.

Exception: A key-locking or twist/turn locking device may be used from the egress side on the main exterior exit door on Group A-3, A-4, A-5, B and I occupancies subject to all of the following:

1. There is a readily visible durable sign on or adjacent to the door stating "THIS EXIT TO REMAIN UNLOCKED WHEN THIS BUILDING IS OCCUPIED." The sign shall be in letters no less than 1 inch high on a contrasting background.
2. The locking device must be of a type that will be readily distinguishable as locked.
3. The main exit door is a single door or one pair of doors.
4. When unlocked, the door or both leaves of the pair must be free. The use of the key-locking device may be revoked by the Building Official for due cause.

- (b) **Hardware height.** Door handles, pulls, latches, locks and other operating devices shall be installed 34 inches minimum and 48 inches maximum above the finished floor in compliance with the *EPCOT Accessibility Code for Building Construction*.

Exception: Access doors or gates in barrier walls and fences protecting pools, spas and hot tubs shall be permitted to have operable parts of the release of latch on self-latching devices at 54 inches maximum above the finished floor or ground, provided the self-latching devices are not also self-locking devices operated by means of a key, electronic opener or integral combination lock.

- (c) **Special egress-control devices.** When approved by the Building Official, exit and exit access doors in A, E and H occupancies may be equipped with approved, listed special egress-control devices of the time-delay type, provided the building is protected throughout by an approved automatic sprinkler system and an approved automatic smoke detection system. Such devices shall conform to all of the following:

1. Automatically deactivate the egress-control device upon activation of either the sprinkler system or the detection system.
2. Automatically deactivate the egress-control device upon loss of electrical power to any one of the following:
 - (a) The egress-control device.
 - (b) The smoke detection system.
 - (c) Exit illumination as required.
3. Be capable of being deactivated by a signal from a switch located in an approved location.
4. Initiate an irreversible process that will deactivate the egress-control device whenever a manual force of not more than 15 pounds is applied for two seconds to the panic bar or other door-latching hardware. The egress-control device shall deactivate within an approved time period not to exceed a total of 15 seconds. The time delay established for each egress-control device shall not be field adjustable.
5. Actuation of the panic bar or other door-latching hardware shall activate an audible signal at the door.
6. The unlatching shall not require more than one operation.
7. On the door adjacent to the release device, there is a readily visible, durable sign in letters at least 1 inch high and at least $\frac{1}{8}$ inch in stroke width on contrasting background that reads "PUSH UNTIL ALARM SOUNDS DOOR CAN BE OPENED IN 15 SECONDS."

804.4 Width and height. Every exit or exit access doorway shall permit the installation of a door not less than 3 feet wide and not less than 6 feet, 8 inches high. The door shall be capable of opening at least 90 degrees and the clear width shall be

not less than 32 inches. In computing the means-of-egress width required by Subsection 803.2, the net dimension of any intervening door shall be used. Door closers and stops shall not reduce headroom to less than 78 inches.

804.5 Door leaf width. The width of a leaf of a pair of exit or exit access doors shall not exceed 4 feet.

804.6 Special doors. Sliding, revolving and overhead doors shall not be used as required exit or exit access doors, except as otherwise provided.

804.7 Egress from doors. Every required door shall have immediate access to an approved means of egress.

804.8 Change in floor level at doors. Regardless of the occupant load, there shall be a floor or landing on each side of an exit or exit access door. The floor or landing shall be at the same elevation on each side of the doorway, and the length and width of the landing shall be at least equal to the width of the doorway it serves. Thresholds for doorways required to be accessible shall comply with Subsection 503.9.

Exceptions:

1. Variations in elevation due to differences in finish materials, but not more than $\frac{1}{2}$ inch.
2. Exterior decks, patios or balconies that are part of a Group R-1 or R-2 occupancy and are not required to be accessible shall be not more than 2 inches below the finished floor level of the adjacent interior space of the guest room or dwelling unit.
3. In Group R-3 occupancies, a door may open inward at the top step of a flight of stairs or on an exterior landing when the first step or the exterior landing is not more than $7\frac{1}{2}$ inches below the floor level.
4. A maximum $\frac{3}{4}$ inch threshold is permitted for sliding glass doors serving any guest room. The height is measured from the top of the interior finished floor. Typical allowances for carpeted finishes are $\frac{1}{4}$ inch for padding and $\frac{1}{4}$ inch for carpet. The interior floor must be ramped to the threshold with a slope that does not exceed 1:20 in order to provide the $\frac{3}{4}$ inch maximum height described above. The Building Official, where space limitations prohibit the use of a 1:20 slope or less, may approve greater slopes. [See *EPCOT Accessibility Code for Building Construction* Section 405.] A slope between 1:10 and 1:12 will be considered for a maximum rise of 6 inches. A slope between 1:8 and 1:10 will be considered for a maximum rise of 3 inches. A slope steeper than 1:8 is not allowed. The maximum height difference between the top of the interior finished floor (interior of the door to the exterior) cannot exceed 2 inches as required in Subsection 804.8 of the *EPCOT Building Code*. The Building Official may permit a greater step-down where it is necessary to protect the integrity of the unit from wind/water damage. Accessible door thresholds and changes in level shall comply with *EPCOT Accessibility Code for Building Construction* Section 404.

5. Exterior doors providing roof access to normally unoccupied roofs may have a threshold not exceeding 7 inches in height.

804.9 Identification. Glass doors shall conform to the requirements of Section 1005, and EPCOT Standards 1005-1 and 1005-2, and shall be identified in accordance with Subsection 1005.1.

804.10 Additional doors. Exterior doors not required as exits, but normally used as such, shall comply with the requirements of Subsections 804.2 and 804.3.

804.11 Fire doors in heater and equipment rooms. See Subsection 503.18(e).

804.12 Revolving doors.

- Each revolving door shall be capable of collapsing into a book-fold position with parallel egress paths providing an aggregate width of not less than 36 inches.
- A revolving door shall not be located within 10 feet of the foot of or top of stairs or escalators. A dispersal area shall be provided between the stairs or escalators and the revolving doors.
- The revolutions per minute for a revolving door shall not exceed the following:

INSIDE DIAMETER (feet and inches)	POWER-DRIVEN TYPE SPEED CONTROL (RPM)	MANUAL-TYPE SPEED CONTROL (RPM)
6-6	11	12
7-0	10	11
7-6	9	10
8-0	9	10
8-6	8	9
9-0	8	9
9-6	7	8
10-0	7	8

- Each revolving door shall have a conforming side-hinged swinging door in the same wall as the revolving door and within 10 feet.

Exception: A revolving door may be used without an adjacent swinging door for street floor elevator lobbies if a stairway, escalator or door from other parts of the building does not discharge through the lobby and the lobby does not have any occupancy or use other than as a means of travel between elevators and street.

- A revolving door to be credited as a component of a means of egress shall comply with Paragraphs (a) through (e) and the following conditions:
 - Revolving doors shall not be given credit for more than 50 percent of the required exit capacity.
 - Each revolving door shall be credited with not more than 50 persons capacity.
 - Each revolving door shall be capable of being collapsed when a force of not more than 130

pounds is applied within 3 inches of the outer edge of a wing.

- A revolving door not used as a component of a means of egress shall have a collapsing force of not more than 180 pounds.

Exception: A revolving door may have a collapsing force set in excess of 180 pounds if the collapsing force is reduced to not more than 130 pounds when at least one of the following is satisfied:

- There is a power failure or power is removed to the device holding the wings in position.
- There is an actuation of the automatic sprinkler system when such system is provided.
- There is an actuation of a smoke detection system that is installed to provide coverage in all areas within the building, which are within 75 feet of the revolving doors.
- There is the actuation of a manual control switch, which reduces the holding force to below the 130-pound level. Such switch shall be in an approved location and shall be clearly identified.

804.13 Closing devices for exit and exit access corridor doors.

- Exit doors, including doors that protect openings in horizontal exits, exit passageways and exit enclosures, and doors in fire-resistance-rated exit access corridors, shall normally be in the closed position. Such doors shall be self-closing or automatic closing in accordance with Paragraph (b). Closing devices shall comply with NFPA 80.

Fire-rated doors shall not be secured in such a manner to prevent the self-closing or automatic-closing devices from providing the required opening protection.

- When approved by the Building Official, doors shall be permitted to be automatic closing provided that each of the following are met:
 - Upon release of the hold-open mechanism, the door becomes self-closing.
 - The release device is designed so that the door instantly releases manually and upon release becomes self-closing, or the door can be readily closed.
 - The automatic-closing mechanism or medium is activated by the operation of approved smoke detectors installed in accordance with the requirements for smoke detectors for door-release service in NFPA 72.
 - Upon loss of power to the hold-open device, the hold-open mechanism is released and the door becomes self-closing.
 - The release by means of smoke detection of one door in a stair enclosure results in closing all doors serving that stair enclosure.

SECTION 805 CORRIDORS AND EXTERIOR EXIT BALCONIES

805.1 Scope.

- (a) This Section shall apply to every corridor and exterior exit balcony used as a means of egress for an occupant load of more than 10. Subsection 805.4 shall apply regardless of occupant load.
- (b) Corridors and exterior exit balconies shall be designed in accordance with Subsection 503.11 and Section 902, and shall be fire protected as required in Chapter 6.

805.2 Width. Corridors and exterior exit balconies shall have a width not less than that required by Subsection 803.2, but in no case be less than 44 inches wide. For special requirements for Group D and E occupancies, see Sections 819 and 820.

805.3 Height. Corridors and exterior exit balconies shall have a clear height of not less than 7 feet.

805.4 Projections.

- (a) The required width of corridors and exterior exit balconies shall be unobstructed. Trim and handrails, and doors when fully open, shall not reduce required width by more than 7 inches. Doors in any position shall not reduce the required width by more than 12 inches.
- (b) Exterior exit balconies shall not project into an area where protected openings are required.

805.5 Dead ends. Length of dead ends of corridors and exterior exit balconies shall be not more than 20 feet.

805.6 Availability of exits. Where more than one exit or exit access doorway is required, the exits or exit access doorways shall be arranged so that it is possible to go in either direction from any point in a corridor or exterior exit balcony to a separate exit or exit access doorway, except from dead ends permitted in Subsection 805.5.

805.7 Construction.

- (a) Corridor walls and ceilings shall be not less than 1-hour fire-resistive construction.

Exceptions:

1. Exterior balcony railings.
2. Corridors in one story, single occupancy Group I.
3. Corridors formed by temporary partitions regulated by Subsection 709.2 that do not exceed 6 feet, 0 inches in height.
4. Corridor walls that are also exterior walls of a building.
5. Single tenant spaces or suites not exceeding 20,000 square feet, limited to Group B office use only. Such spaces shall have either direct exits to the exterior or be served by a protected corridor with a fire-resistance rating of not less than 1-hour, which provides direct access to exits. Each suite shall be separated from other parts of the building by walls constructed as tenant separations in accordance with Subsec-

tion 502.5(b), with a fire-resistance rating of not less than 1-hour.

- 6. For buildings of unprotected construction Type IV, V, or VI, ceiling construction should be consistent with type of construction.
 - 7. Where the corridor ceiling is constructed as required for the corridor walls, the walls shall be permitted to terminate at the upper membrane of such ceiling assembly.
- (b) The floors, walls and ceilings of exterior exit balconies shall meet the requirements applicable to the type of construction of the building. Exterior exit balconies shall be separated from the interior of the building by walls and protected openings as required for corridors.

Exception: Separation is not required where the exterior exit balcony is served by at least two stairs and a dead-end travel condition does not require egress past an unprotected opening to reach a stair.

Exterior exit balconies shall have guardrails designed in accordance with Subsection 902.2(h). The open area above the guardrail shall be constructed to prevent the accumulation of smoke and toxic gases.

805.8 Openings.

- (a) Where corridor walls are required to be 1-hour fire-resistive construction, every interior door opening shall be protected by a tight-fitting smoke and draft assembly having a fire protection rating of not less than 20 minutes when tested in accordance with EPCOT Standard 7-2, without the hose stream test. Wired glass shall be set in steel frame. A closing device shall be required.
- (b) Other openings shall be protected by a fixed wired glass not less than 1/4 inch thick set in steel frame or a 1-hour, fire-rated automatic-closing device or listed window assembly with fire-protection-rated glazing of not less than 3/4 hour. Fire-protection-rated glazing shall be tested in accordance with, and shall meet the acceptance criteria of, NFPA 257 or UL 9. The area of all openings other than doors in any part of a corridor shall not exceed 25 percent of the area of the corridor wall of the room from which the corridor is separated. For occupancy separations, see Section 502, and for fire division wall requirements, see Section 708.

Exception: Fire-resistance-rated glazing tested as part of a 1-hour fire-resistance-rated wall assembly in accordance with ASTM E119 or UL 263 shall be permitted in fire doors and fire window assemblies in accordance with their listings and shall not otherwise be required to comply with this Section.

- (c) Duct penetrations of corridor walls shall be protected with listed smoke dampers in accordance with the *EPCOT Mechanical Code*.

805.9 Use of corridors. Storage, lockers, electronic equipment, panels, electronic panels or other obstructions shall not be permitted in corridors.

Exception: Electrical boxes and fire alarm control panels that meet the requirements of the exception for Subsection

707.10.3.2 and Section 307 of the *EPCOT Accessibility Code for Building Construction*.

805.10 Corridor continuity. Fire-resistance-rated corridors shall be continuous from the point of entry to an exit, and shall not be interrupted by intervening rooms.

Exception: Foyers, lobbies or reception rooms constructed as required for corridors shall not be construed as intervening rooms.

SECTION 806 STAIRWAYS

806.1 Scope. Stairways shall conform to the requirements of this Section, except that stairs or ladders used to access or move equipment may be exempted from these requirements by the Building Official.

806.2 Width.

- (a) The width of stairways shall be determined in accordance with Subsection 803.2 and as required herein. Stairways serving an occupant load of more than 50 shall be not less than 44 inches wide. Stairways serving an occupant load of 50 or less shall be not less than 36 inches wide.
- (b) Trim shall not reduce the required width of a stairway by more than $3\frac{1}{2}$ inches into the required width.
- (c) Handrails may project from each side of a stairway a distance of $3\frac{1}{2}$ inches into the required width.

806.3 Treads and risers.

- (a) Stairway risers shall be not less than 4 inches or more than 7 inches high and treads shall be not less than 11 inches wide.
- (b) Treads shall be of uniform depth and risers of uniform height in any flight of stairs. There shall be no variation exceeding $\frac{3}{8}$ inch in the depth of adjacent treads or in the height of adjacent risers. Tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads. Stair treads and risers shall be of uniform size and shape. The tolerance between the largest and smallest riser or between the largest and smallest tread shall not exceed $\frac{3}{8}$ inch in any flight of stairs.

Exceptions:

1. Where the bottom or top riser adjoins a sloping public way, walk or driveway having an established grade and serving as a landing, a variation in the height of the riser of not more than 3 inches for every 3 feet of stairway width is permitted.
2. Aisle stairs in accordance with Subsection 816.6.
- (c) The slope of the walking surface of treads in any direction shall not exceed $\frac{1}{4}$ inch per foot (a slope of 1 in 48), except that the radius of curvature at the leading edge of the tread shall not be greater than $\frac{1}{2}$ inch. Beveling or rounding of nosings shall not exceed $\frac{1}{2}$ inch in a horizontal dimension. Risers shall be solid and vertical or sloped from the underside of the leading edge of the tread above at an angle not

more than 30 degrees from the vertical. The leading edge (nosings) of treads shall project not more than $1\frac{1}{4}$ inches beyond the tread below. All projections of the leading edges shall be of uniform size, including the leading edge of the floor at the top of a flight of stairs.

Exceptions:

1. Stairways required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.
2. Solid risers are not required for stairways that are not required to be in an enclosure by Subsection 809.1, provided the opening between treads does not permit the passage of a sphere with a diameter of 4 inches.
3. Where access to a performance platform is strictly limited to performers and technicians, an 8-inch stair riser shall be permitted.

806.4 Special stairways.

- (a) Special stairways shall conform to the requirements of this Section. Special stairways include circular (curved) stairways, stairways with winders and spiral stairways. For the purpose of this Section, winders are defined as treads with nonparallel edges.
- (b) A circular (curved) stairway may be used as a component in a means of egress when not less than 4 feet wide, the smallest radius is not less than twice the stair width, and all treads and risers in any one flight between landings have uniform tolerances as provided in Subsection 806.3(b). The minimum tread width at the narrow end shall be not less than 10 inches and the minimum tread depth measured 12 inches from the narrower end shall be not less than 11 inches.
- (c) Except for circular (curved) stairways and spiral stairways as provided for herein, stairways with winders are not permitted as a component in a means of egress, except within dwelling units. Risers on stairways with winders shall conform to Subsection 806.3. The minimum tread width of any winder shall be not less than 10 inches at the narrow end and the minimum tread depth measured 12 inches from the narrow end shall not be less than 11 inches.
- (d) Spiral stairways are stairways having a closed circular form in its plan view with uniform section-shaped treads attached to and radiating from a minimum-diameter supporting column. Spiral stairways are permitted to be used as a component in a means of egress only within dwelling units or from a space not more than 250 square feet in area and serving not more than five occupants, or from galleries, catwalks and gridirons within a Group A occupancy. The minimum stairway width shall be not less than 26 inches. The risers shall be sufficient to provide a headroom of 78 inches minimum, but the riser height shall not exceed $9\frac{1}{2}$ inches. The clear tread depth at a point 12 inches from the narrow end shall be $7\frac{1}{2}$ inches minimum. All treads shall be identical. Handrails complying with Subsection 806.8 shall be provided.

- (e) **Industrial stairways.** Fixed industrial interior and exterior stairs around machinery, tanks and other equipment, and stairs leading to or from floors, platforms or pits and where the requirements of Subsection 806.3(a) are technically infeasible shall comply with this Section. This Section does not apply to stairs used for fire exit purposes. The minimum width requirement for fixed industrial stairs shall be 22 inches. Fixed industrial stairs shall be installed at angles to the horizontal of between 30 degrees and 50 degrees. Any uniform combination of rise/tread dimensions may be used that will result in a stairway angle to the horizontal within the permissible range. Riser height and tread width shall be uniform with no variation between adjacent treads or risers exceeding $\frac{3}{8}$ inch (see Table 8.2).

TABLE 8.2
INDUSTRIAL STAIRWAYS

ANGLE TO HORIZONTAL	RISE (Inches)	TREAD (Inches)
30 degrees 35'	6 $\frac{1}{2}$	11
32 degrees 08'	6 $\frac{3}{4}$	10 $\frac{3}{4}$
33 degrees 41'	7	10 $\frac{1}{2}$
35 degrees 16'	7 $\frac{1}{4}$	10 $\frac{1}{4}$
36 degrees 52'	7 $\frac{1}{2}$	10
38 degrees 29'	7 $\frac{3}{4}$	9 $\frac{3}{4}$
40 degrees 08'	8	9 $\frac{1}{2}$
41 degrees 44'	8 $\frac{1}{4}$	9 $\frac{1}{4}$
43 degrees 22'	8 $\frac{1}{2}$	9
45 degrees 00'	8 $\frac{3}{4}$	8 $\frac{3}{4}$
46 degrees 38'	9	8 $\frac{1}{2}$
48 degrees 16'	9 $\frac{1}{4}$	8 $\frac{1}{4}$
49 degrees 54'	9 $\frac{1}{2}$	8

- (f) **Ship's ladders.** Ship's ladders are permitted to be used as a component of a means of egress from catwalks, control rooms or elevated facility observation stations not more than 250 square feet with not more than three occupants and for access to equipment and unoccupied roofs.

Ship's ladders shall have a minimum tread depth of 5 inches. The ladder shall be sloped such that the total depth of each consecutive two treads, measured horizontally from the nose of the lower tread to the back of the next tread above, is not less than 8 $\frac{1}{2}$ inches. The maximum riser height between treads shall be 9 $\frac{1}{2}$ inches.

Handrails shall be provided on both sides of the ship's ladders. The minimum clear width at and below the handrails shall be 20 inches.

806.5 Landings. The length and width of landings shall be at least equal to the width of the stairway that it serves. The dimension measured in the direction of travel need not be more than 4 feet when the stairway has a straight run. Landings shall not be reduced in width by more than 3 $\frac{1}{2}$ inches by a door when fully open. (See Subsection 804.8.)

806.6 Basement stairways. When a basement stairway and a stairway from an upper story terminate in the same exit enclosure, an approved barrier shall be provided to prevent persons

from unintentionally continuing on into the basement. In addition, directional exit signs shall be provided as specified in Subsection 812.1.

806.7 Distance between landings. There shall be not more than 12 feet vertical distance between landings.

806.8 Handrails.

- (a) Stairways shall have handrails on each side, and every stairway more than 88 inches wide shall have intermediate handrails dividing the stairway into sections not more than 88 inches wide.

Exceptions:

1. Stairways within dwelling units, spiral stairways and aisle stairs serving seating only on one side may have one handrail, except that stairways open on one or both sides shall have handrails on the open sides.
 2. Stairways serving Group R-3 occupancies having less than four risers need not have handrails.
 3. Aisle stairways having a center handrail in accordance with Subsection 817.7(c) need not have additional handrails.
- (b) Handrails shall be placed not less than 34 inches, nor more than 38 inches, above the nosing of treads or path of travel. Handrail height shall be uniform. Clear space between a handrail and a wall shall be 1 $\frac{1}{2}$ inches. A handrail and a wall, or other surface adjacent to the handrail, shall be free of any sharp or abrasive elements. Ends of handrails shall be returned smoothly to the floor, wall or post, or shall be continuous to the handrail of an adjacent stair flight. Where handrails are not continuous between flights, the handrails shall extend horizontally at least 12 inches beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser.

Exception: Handrails on stairs required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.

- (c) Handrail gripping surfaces shall be continuous, without interruption by newel posts or other obstructions. Handrails with a circular cross section shall have an outside diameter of at least 1 $\frac{1}{4}$ inches and not greater than 2 inches or shall provide equivalent graspability. If the handrail is not circular, it shall have a perimeter dimension of at least 4 inches and not greater than 6 $\frac{1}{4}$ inches with a maximum cross-section dimension of 2 $\frac{1}{4}$ inches.

Exception: Handrails on stairs required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.

806.9 Guardrails. Guardrails shall be provided as required in Subsection 503.11 and designed as required in Subsection 902.2(h).

806.10 Exterior stairway protection. Openings in an exterior wall below or within 10 feet measured horizontally of a required exterior stairway serving a building of more than two stories shall be protected by fixed wired glass, $\frac{3}{4}$ -hour

fire-resistive-rated glazing or a self-closing fire door having a $\frac{3}{4}$ -hour fire-resistive rating. (See Subsection 704.3.)

Exception: Openings may be unprotected when two separated exterior stairways serve an exterior exit balcony.

806.11 Stairway construction, interior.

- (a) Interior stairways and stair platforms in buildings of Type I construction as specified in Chapter 6 shall be of noncombustible materials.
- (b) In buildings of other than Type I construction, stairways may be constructed of any material permitted by this Code for the specific type of construction, except that in heavy timber buildings, stairways shall be constructed with wood treads and risers of not less than 2-inch nominal thickness. Where built on laminated or plank inclines as required for floors, stairs may be 1-inch nominal thickness or may be constructed as required for Type I buildings.
- (c) In buildings of more than three stories, stairway construction shall be noncombustible.
- (d) The walls and soffits of enclosed usable space under interior stairs shall be protected by 1-hour fire-resistance-rated construction or the fire-resistive rating of the stair enclosure, whichever is greater. Access to the enclosed usable space shall not be directly from within the stair enclosure.

Exception: When located within a dwelling unit.

- (e) In buildings exceeding two stories, stairways shall abut on not more than one side of an elevator enclosure.

806.12 Stairway construction, exterior. Exterior exit stairways shall not be used as an element of a required means of egress for Group D occupancies. For occupancies in other than Group D, exterior exit ramps and stairways shall be permitted as an element of a required means of egress for buildings not exceeding six stories above grade plane or having occupied floors more than 75 feet above the lowest level of fire department vehicle access.

Exterior exit ramps and stairways serving as an element of a required means of egress shall be open on at least one side. An open side shall have a minimum of 35 square feet of aggregate open area adjacent to each floor level and the level of each intermediate landing shall be not less than 50 percent open, whichever is greater. The required open area shall be located not less than 42 inches above the adjacent floor or landing level.

- (a) Exterior stairways shall be constructed as required in Chapter 6, except that in Type IV, V and VI buildings, stairways may be of wood of not less than 2-inch nominal thickness.
- (b) Exterior stairways shall be protected as required for exterior walls where there is exposure to adjacent structures or to property lines.
- (c) Exterior stairways shall not project into an area where openings are required to be protected.
- (d) The walls and soffits of enclosed usable space under exterior stairs shall be protected by 1-hour fire-resis-

tance-rated construction or the fire-resistive rating of the stair enclosure, whichever is greater. Access to the enclosed usable space shall not be directly from within the stair enclosure.

- (e) Exterior stairways shall be arranged to avoid any impediments to their use by persons having a fear of high places. Exterior stairways more than 36 feet above the finished ground level, other than previously approved existing stairs, shall be provided with an opaque visual obstruction not less than 48 inches in height.

806.13 Stairway to roof. In every building of three or more stories, one stairway shall extend to the roof surface, unless the slope of the roof exceeds 4 feet in 12 feet.

806.14 Headroom. Every required stairway shall have a headroom clearance of not less than 6 feet, 8 inches. Such clearance shall be established by measuring vertically from a plane parallel and tangent to the stairway tread nosing to the soffit above at all points.

SECTION 807 RAMPS

807.1 Ramps as exits. A ramp conforming to the requirements of this Section may be used as a required exit.

807.2 Width. The width of ramps shall be as required for corridors.

807.3 Slope. The slope of a ramp measured in the direction of travel shall not exceed 1 foot in 12 feet. The slope measured perpendicular to the direction of travel (cross slope) shall not be steeper than one unit vertical in 50 units horizontal.

Exceptions:

1. Ramps complying with Subsection 816.6(j).
2. Ramps required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.

807.4 Handrails. A ramp with slope exceeding 1 foot in 20 feet shall have handrails as required for stairways, except that intermediate handrails shall not be required. If handrails are not continuous, they shall extend at least 12 inches beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface.

Exception: Ramps with a rise of 6 inches or less.

807.5 Construction. Ramps shall be constructed as required for stairways.

807.6 Surface. The surface of ramps shall be roughened or shall be of nonslip materials.

807.7 Landings. Ramp runs shall have landings at the bottom and top, at turning points, at doors that open onto the ramp and at other locations so that no ramp run has a rise more than 30 inches. Landings shall be at least as wide as the widest ramp run adjoining the landing. The landing length shall be at least 60 inches minimum. Where changes of direction occur at landings provided between ramp runs, the landing shall be 60 inches by 60 inches minimum. The slope of landings in

any direction shall not be steeper than one unit vertical in 50 units horizontal. Changes in level are not permitted.

Exceptions:

1. Landings on ramps in individual dwelling units of Group R-2 and R-3 occupancies are permitted to be 36 inches by 36 inches minimum.
2. Landings on ramps required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.

SECTION 808 HORIZONTAL EXITS

808.1 As required exit. When conforming to the provisions of this Chapter, a horizontal exit may be considered as a required exit.

808.2 Openings. All openings in a wall pierced for a horizontal exit shall have an approved opening protective with a fire-resistive rating of not less than 1½ hours. Such opening protectives shall be maintained in operating condition as self-closing or automatic closing as provided in Subsection 704.3.

808.3 Discharge areas. A horizontal exit shall lead to a floor area having capacity for an occupant load not less than the occupant load served by such exit. The area into which the horizontal exit leads shall be provided with exits other than additional horizontal exits, as required by Section 803. The capacity shall be determined by allocating 3 square feet of net clear floor area for each occupant.

Exception: The net floor area allowable per occupant shall be as follows for the indicated occupancies:

1. Six square feet per occupant for occupancies in Group D-1.
2. Fifteen square feet per occupant for ambulatory occupancies in Group D-3.
3. Thirty square feet per occupant for nonambulatory occupancies in Group D-2.

SECTION 809 EXIT ENCLOSURES

809.1 Enclosures required. Every interior stairway, ramp or escalator shall be enclosed as required in this Section. (See Table 6.2.)

Exceptions:

1. In other than Group D occupancies, an enclosure will not be required for a stairway, ramp or escalator serving only one adjacent floor and not connected with corridors, escalators or stairways serving other floors. For enclosure of escalators in Group B and I occupancies, see Chapter 6.
2. Stairs within a single tenancy of Group R-2 and R-3 occupancies need not be enclosed.

809.2 Enclosure construction. Enclosure walls shall be of not less than 2-hour fire-resistive construction in buildings of

four or more stories, and shall be of not less than 1-hour fire-resistive construction in buildings of less than four stories.

809.3 Openings into enclosures. There shall be no openings into exit enclosures except exit doorways and openings in exterior walls. All exit enclosure doors in an exit enclosure shall have an approved opening protective with a fire-resistive rating of not less than 1 hour where 1-hour shaft construction is permitted, and 1½ hours where 2-hour shaft construction is required. Doors shall be maintained self-closing or shall be automatic closing as provided in Subsection 704.3. All stairway doors shall be unlocked and openable from the stairway side at each floor. The maximum transmitted temperature rise shall be not more than 450°F at the end of 30 minutes of the fire exposure specified in EPCOT Standard 7-2.

809.4 Extent of enclosure. Stairway and ramp enclosures shall include landings, parts of floors connecting stairway flights and a corridor on the ground floor leading from the stairway to the exterior of the building. Enclosed corridors or passageways shall not be required from unenclosed stairways.

809.5 Barrier at grade level exit. A stairway in an exit enclosure shall not continue below the grade level exit unless an approved barrier is provided at the ground level to prevent persons from unintentionally continuing to the lower level.

809.6 Prohibited uses. A stair enclosure shall be used for no purpose other than as an exit stairway.

SECTION 810 SMOKE-PROTECTED ENCLOSURES

810.1 Smokeproof enclosures and pressurized stairways. In buildings required to comply with Section 718 or 719, each of the exit enclosures serving a story with a floor surface located more than 75 feet above the lowest level of fire department vehicle access shall be a smokeproof enclosure or pressurized stairway in accordance with Subsection 720.20. The support-frame shall be protected as set forth in Table 6.2.

810.1.1 Termination and extension. A smokeproof enclosure or pressurized stairway shall terminate at an exit discharge or a public way. The smokeproof enclosure or pressurized stairway shall be permitted to be extended by an exit passageway in accordance with Section 811. The exit passageway shall be without openings other than the fire door assembly required by Subsection 809.3 and those necessary for egress from the exit passageway. The exit passageway shall be separated from the remainder of the building by 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 705, or both.

Exceptions:

1. Openings in the exit passageway serving a smokeproof enclosure are permitted where the exit passageway is protected and pressurized in the same manner as the smokeproof enclosure, and openings are protected as required for access from other floors.
2. Openings in the exit passageway serving a pressurized stairway are permitted where the exit pas-

sageway is protected and pressurized in the same manner as the pressurized stairway.

3. The fire barrier separating the smokeproof enclosure or pressurized stairway from the exit passageway is not required, provided the exit passageway is protected and pressurized in the same manner as the smokeproof enclosure or pressurized stairway.

810.1.2 Enclosure access. Access to the stairway within a smokeproof enclosure shall be by way of a vestibule or an open exterior balcony.

Exception: Access is not required by way of a vestibule or exterior balcony for stairways using the pressurization alternative complying with Subsection 720.20.5.

810.1.3 Emergency lighting. The stairshaft and the vestibule shall be provided with emergency lighting. The standby generator, which is installed to operate the mechanical ventilation equipment, may be used for standby emergency lighting power supply.

810.1.4 Air-conditioned buildings. In buildings with air-conditioning systems or pressure air supply, a detector conforming to the requirements of Subsection 704.3(c) shall be placed in the main circulating air supply duct in the downstream side of any filters and so located as to operate and shut off the building system when smoke enters the airstream, or such device may be installed in each room or space served by a return air duct.

810.1.5 Periodic tests of mechanical equipment. The building engineer shall test the mechanical ventilating equipment every 7 days and shall maintain a record of the results. The record shall be available for inspection by the Building Official or his representative.

SECTION 811 EXIT PASSAGEWAYS

811.1 Exit passageways. An exit passageway shall not be used for any purpose other than as a means of egress. Passageways shall have wall, floor and ceiling assemblies of the same construction type as the building, but such assemblies shall be not less than 2-hour fire-resistive construction. Openings in exit passageways shall be limited to those necessary for exit access to the exit passageway from normally occupied spaces and for egress from the exit passageway. Elevators shall not open into an exit passageway. Penetrations into and openings through an exit passageway are prohibited, except for required exit doors, equipment and ductwork necessary for independent pressurization, sprinkler piping, standpipes, electrical raceway for fire department communication and electrical raceway serving the exit passageway and terminating at a steel box not exceeding 16 square inches. Such penetrations shall be protected in accordance with Subsection 707.10.

811.2 Width.

- (a) Every exit passageway shall be at least as wide as the required total width of the tributary exits, but not less than 44 inches. The width shall be based on the occupant load served.

Exception: Exit passageways serving an occupant load of less than 50 shall be not less than 36 inches in width.

- (b) The required width of exit passageways shall be unobstructed. Doors, when fully opened, and handrails shall not reduce the required width by more than 7 inches. Doors in any position shall not reduce the required width by more than one-half.

811.3 Openings. All openings into an exit court less than 10 feet wide shall be protected with self-closing doors having a ³/₄-hour fire-resistive rating or with fixed wired glass.

Exception: All openings more than 10 feet above the floor of the exit court may be unprotected.

SECTION 812 EXIT DISCHARGE

812.1 General. Exits shall discharge directly to the exterior of the building. The exit discharge shall be at grade or shall provide direct access to grade. The exit discharge shall not reenter a building.

Exceptions:

1. A maximum of 50 percent of the number and capacity of the exit enclosures is permitted to egress through areas on the level of discharge when each of the following are met:
 - 1.1. Such exit enclosures shall provide egress to a free and unobstructed way to the exterior of the building that is readily visible and identifiable from the point of termination of the exit enclosure.
 - 1.2. The entire area of the level of discharge is separated from areas below by construction conforming to the fire-resistance rating for the exit enclosure.
 - 1.3. The egress path from the exit enclosure on the level of discharge is protected throughout by an approved automatic sprinkler system.
2. A maximum of 50 percent of the number and capacity of the exit enclosures is permitted to egress through a vestibule when each of the following are met:
 - 2.1. The entire area of the vestibule is separated from areas below by construction conforming to the fire-resistance rating for the exit enclosure.
 - 2.2. The depth from the exterior of the building is not greater than 10 feet and the length is not greater than 30 feet.
 - 2.3. The area is separated from the remainder of the level of exit discharge by construction providing protection at least the equivalent of approved wired glass.
 - 2.4. The area is used only for means of egress and exits directly to the outside.

812.2 Exit discharge capacity. The capacity of the exit discharge shall be not less than the required discharge capacity of the exits being served.

812.3 Exit discharge location. Exterior balconies, stairways and ramps shall be located at least 10 feet from adjacent lot lines and from other buildings on the same lot unless the adjacent building exterior walls and openings are protected in accordance with Table 6.2 and Subsection 701.4 based on fire separation distances.

812.4 Exit discharge components. Exit discharge components shall be sufficiently open to the exterior so as to minimize the accumulation of smoke and toxic gases.

812.5 Exit discharge through egress courts.

- (a) Egress courts shall be at least as wide as the required total width of the tributary exits, but not less than 44 inches. The width shall be based on the occupant load served.

Exception: Egress courts serving an occupant load of less than 50 shall be not less than 36 inches in width.

- (b) The required width of egress courts shall be unobstructed. Doors, when fully opened, and handrails shall not reduce the required width by more than 7 inches. Doors in any position shall not reduce the required width by more than one-half. Where an egress court exceeds the minimum required width and the width of such egress court is then reduced along the path of exit travel, the reduction in width shall be effected gradually by a guardrail at least 42 inches high. The guardrail shall make an angle of not more than 30 degrees with the axis of the egress court.
- (c) Where an egress court is less than 10 feet in width, the egress court walls shall be not less than 1-hour fire-resistance-rated exterior walls for a distance of 10 feet above the floor of the court, and openings therein shall be equipped with fixed or self-closing, $\frac{3}{4}$ -hour opening protective assemblies.

812.6 Access to a public way. The exit discharge shall provide a direct and unobstructed access to a public way.

Exception: Where access to a public way cannot be provided, a safe dispersal area shall be provided where all of the following are met:

1. The area shall be sized to accommodate at least 5 square feet for each person.
2. The area shall be located on the same property at least 50 feet away from the building requiring egress.
3. The area shall be permanently maintained and identified as a safe dispersal area.

The area shall be provided with a safe and unobstructed path of travel from the building.

SECTION 813 EXIT SIGNS AND EGRESS ILLUMINATION

813.1 Exit signs.

- (a) All required exits shall be equipped with approved exit signs in all occupancies with an occupant load of 50 or more persons and at the entrance to all interior stairways that lead to the exterior.

Exception: In Group D and E occupancies, exit signs shall be required with an occupant load of more than 10 persons.

- (b) Where an exit sign or the exit is not visible from the exit access, directional signs indicating the means of egress shall be provided unless otherwise approved by the Building Official. In no case shall directional exit signs be located more than 100 feet from the nearest visible exit sign.
- (c) All exit and exit directional signs shall have letters at least 6 inches high with a minimum stroke of $\frac{3}{4}$ inch and shall be of distinctive, contrasting color and designation as to be readily visible. Signs shall provide a contrast with decoration, interior finish or other signs.
- (d) All exit and exit directional signs shall be illuminated, externally or internally, by a reliable light source. Externally and internally illuminated signs shall be legible in both the normal and emergency lighting mode. Externally illuminated signs shall be illuminated by not less than 5 footcandles at the illuminated surface and shall have a contrast ratio of not less than 0.5. Illumination of exit signs shall be continuously supplied through separate electric circuits or service. Battery-operated electric lights and portable lanterns shall not be used for primary illumination. Fluorescent or reflective materials may be used as a substitute for any required illumination when approved by the Building Official. (Storage batteries in compliance with Article 700 of the *National Electrical Code* are permitted.)

Exceptions:

1. Where a main entrance serves as an exit and is clearly visible to the occupants, an exit sign is not required over the main entrance door.
2. Exit signs located in a show-type installation may not be illuminated at all times when the building is occupied by the public when all of the following conditions are met:
 - (a) Each installation will be reviewed and approved by the Building Official on a show-by-show review.
 - (b) Each exit sign will be illuminated upon activation of any initiating device or notification appliance, including fire water flow, by the building fire alarm system.

- (c) Each exit sign will be illuminated upon normal power failure.
- (d) Each exit sign will be illuminated upon activation of the building work lights and/or egress illumination.
- (e) Each exit sign shall be connected to either the emergency stop switch located on the show ride console for amusement rides and devices or the show control stop switch on the show control console for amusement attractions and special amusement buildings.
- (e) All exit signs shall be located not higher than 12 inches above the door to the bottom of the required exit sign.

Exception: See Subsection 5-12.401.1(b) for special exit sign location requirements for amusement buildings and amusement attractions.

- (f) Regardless of occupant load, in any case where the exit is not visible or the direction of exit is not clear, exit signage shall be provided indicating the means of egress.

813.2 Egress illumination.

- (a) Except in Group R-3 occupancies, the means of egress serving the occupied portion of the building shall be illuminated to a level of not less than 1 footcandle measured at the floor level whenever the building is occupied. During conditions of stair use, the minimum illumination for new stairs shall be at least 10 footcandles measured at the walking surface.

Exception: In assembly occupancies, the illumination of the walking surfaces of exit access shall be at least 0.2 footcandle measured at the floor level during periods of performances or projections involving directed light.

- (b) For the purposes of this requirement, exit access shall include only designated stairs, aisles, corridors, ramps, escalators and passageways leading to an exit. For the purposes of this requirement, exit discharge shall include only designated stairs, aisles, corridors, ramps, escalators, walkways and exit passageways leading to a public way.
- (c) Required illumination shall be arranged so that the failure of a single lighting unit will not result in an illumination level in any designated area of less than 0.2 footcandle.
- (d) In new construction, when required by the Building Official, a lighting analysis prepared by a lighting engineer shall be provided demonstrating compliance with these requirements.
- (e) Exit signs shall be illuminated at all times when the building is occupied, except as noted in Subsection 813.1(d).
- (f) Directional floor lighting shall be permitted in amusement attractions, special amusement buildings, amusement devices or rides.

- (g) Automatic, motion sensor-type lighting switches shall be permitted within the means of egress, provided that the switch controllers comply with all of the following:

1. The switch controllers are listed.
2. The switch controllers are equipped for fail-safe operation and evaluated for this purpose.
3. The illumination timers are set for a minimum 15-minute duration.
4. The motion sensor is activated by any occupant movement in the area served by the lighting units.
5. The switch controller is activated by activation of the building fire alarm system, if provided.

813.3 Emergency power.

- (a) The power supply for exit signs and egress illumination required by Subsections 813.1 and 813.2 shall normally be provided by the premise's electrical supply system. In the event of power supply failure, emergency sources of power complying with the *EPCOT Electrical Code* shall be permitted.
- (b) The emergency source of power shall provide power for a duration of not less than 90 minutes. Egress illumination shall be arranged to provide initial illumination with light equivalent of not less than an average of 1 footcandle and a minimum at any point of 0.1 footcandle measured along the path of egress at the floor level.
- (c) Illumination levels shall be permitted to decline to 60 percent of the initial level at the end of the emergency lighting duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.

SECTION 814 PANIC HARDWARE

814.1 Panic hardware required. Unless otherwise required in this Code, all exit doors serving an occupant load of 50 or more and Group E occupancies shall be provided with panic hardware or fire exit hardware. Such hardware shall release with an unlatching force of no more than 15 pounds applied to the releasing devices in the direction of the exit travel. Panic hardware may be bars or panels extending not less than one-half the width of the door and placed at heights suitable for the service required, but not less than 30 inches, nor more than 44 inches above, the floor. Whenever panic hardware is used on a labeled fire door, the panic hardware shall be labeled as fire exit hardware.

Exception: Doors for individual classrooms located in a Group E occupancy.

814.2 If balanced doors are used and panic hardware is required, the panic hardware shall be of the pushpad type and the pad shall not extend more than one-half the width of the door measured from the latch side.

814.3 See Subsection 804.3 for exceptions.

SECTION 815 EXIT OBSTRUCTIONS

815.1 Obstruction prohibited. No obstruction shall be placed in an aisle, exit, foyer, passageway or corridor, except as permitted by this Chapter.

SECTION 816 SPECIAL EXIT REQUIREMENTS— GROUP A-1 TO A-5 OCCUPANCIES

816.1 General requirements. Buildings housing Group A-1 to A-5 occupancies shall be provided with means of egress in accordance with the requirements of this Chapter and with the provisions of Subsections 816.2 to 816.7 that follow.

Exception: For show/ride occupancies, see Subsection 803.2(a) for exit widths.

816.2 Main exit. Every Group A-1 occupancy shall have a main exit wide enough to accommodate one-half the total occupant load of the auditorium. The main exit shall be not less than the total width of all aisles, exit passageways and stairways leading thereto, and shall connect to a stairway or ramp leading to a public way.

816.3 Side exits. Every auditorium of a Group A-1 occupancy shall be provided with exits on each side, of sufficient width, to accommodate one-third of the total occupant load served. Side exits shall open directly to a public way, or into an egress court, approved stairway or exit passageway leading to a public way. Side exits shall be accessible from a cross aisle.

816.4 Balcony exits. Balconies having an occupant load of more than 10 shall have two exits directly to an exterior stairway or approved stairway or ramp. Where there is more than one balcony, exits from each shall open to an exterior stairway, enclosed stairway or ramp, and shall be accessible from a cross aisle. The number and distribution of exits shall be as specified in Section 803.

816.5 Stage exits. At least one exit not less than 36 inches wide shall be provided from each side of the stage opening directly or by means of a passageway not less than 36 inches wide to a street or egress court. An exit stairway not less than 2 feet, 6 inches wide shall be provided for egress from each fly gallery. Each tier of dressing rooms shall have at least two means of egress not less than 2 feet, 6 inches wide. All stage exits shall be constructed as required in Section 806, but the stairways required in this Subsection need not be enclosed.

816.6 Aisles.

- (a) Every part of buildings in which seats, tables, merchandise, equipment or similar materials are installed shall have aisles with each aisle leading to an exit.
- (b) With standard seating, aisles shall be not less than 3 feet wide if serving only one side, and not less than 3 feet, 6 inches wide if serving both sides, measured at the point farthest from an exit, cross aisle or foyer. The width shall be increased by 1½ inches for each 5 feet of length toward the exit, cross aisle or foyer.
- (c) With continental and modified-continental seating, as defined in Subsection 801.4 and as specified in Subsection 816.7(a), side aisles shall be not less than 44 inches wide.

- (d) With modified-continental seating, the width of intervening aisles shall be based on 50 percent of the total occupant load served, but not less than 3 feet, 6 inches wide. The width shall be increased by 1½ inches for each 5 feet of length toward the exit, cross aisle or foyer.
- (e) In areas occupied by seats and in Group A occupancies without seats, the line of travel to an exit door by an aisle shall be not more than 150 feet.
- (f) With continental and modified-continental seating, the number of seats per row of seats may be increased subject to the conditions of Subsection 816.7(b).
- (g) With continental seating, the number of intervening seats may be increased to 29 when exit doors are provided along each side aisle of the row of seats at the rate of one pair of exit doors for each five rows of seats. Such exit doors shall have a minimum clear width of 66 inches.
- (h) Aisles shall terminate in a cross aisle, foyer or exit. The width of the cross aisle shall be not less than the sum of the required width of the widest aisle plus 50 percent of the total required width of the remaining aisles leading thereto. In Group A and E occupancies, aisles shall not form dead ends more than 20 feet long.
- (i) Vomitories connecting the foyer or main exit with the cross aisles shall have a total net width of not less than the sum of the required width of the widest aisle leading thereto, plus 50 percent of the total required width of the remaining aisles leading thereto.
- (j) Where aisles are sloped, the slope shall be not more than 1 foot in 8 feet.

Exception: In Group A-1, A-2 and A-3 occupancies, the slope of the ramp may be 1 foot in 5 feet without handrails.

816.7 Seats and clear width of rows.

- (a) Where seating rows have 14 or fewer seats, the row minimum clear width shall be not less than 12 inches measured as the clear horizontal distance from the back of the row ahead and the nearest projection of the row behind. Where chairs have automatic or self-rising seats, the measurement shall be made with seats in the raised position. Where any chair in the row does not have an automatic or self-rising seat, the measurements shall be made with the seat in the down position. For seats with folding tablet arms, row spacing shall be determined with the tablet arm down.
- (b) For rows of seating served by aisles or doorways at both ends, there shall be no more than 100 seats per row and the row minimum clear width of 12 inches shall be increased by 0.3 inch for every additional seat beyond 14, but the minimum clear width need not exceed 22 inches.
- (c) For rows of seating served by an aisle or doorway at one end only, minimum clear width of 12 inches between rows shall be increased by 0.6 inch for every additional seat beyond seven, but the minimum clear width need not exceed 22 inches.
- (d) For rows of seating served by an aisle or doorway on one end only, the path of travel shall not exceed 30 feet

from any seat to a point where a person has a choice of two paths of travel to two exits.

816.8 Continental and modified seating. With continental and modified-continental seating, the spacing of rows of unoccupied seats shall provide a clear width between rows of seats measured horizontally as follows: (automatic or self-rising seats shall be measured in the seat-up position, other seats shall be measured in the seat-down position)

Number of Seats in Row	Clear Space (Inches)
1 to 18	18
19 to 35	20
36 to 45	21
46 to 59	22
60 or more	24

Exit doors shall be provided along each side aisle of the row of seats at a rate of one pair of doors for each five rows of seats. Each pair of exit doors shall provide a minimum clear width of 66 inches discharging into a foyer, lobby or exterior of building. There shall be not more than five seat rows between pairs of doors.

816.9 Foyers and lobbies. In theaters and similar Group A occupancies, where persons are admitted to the building at times when seats are not available and are allowed to wait in a lobby or similar space, such use of lobby or similar space shall not encroach upon the required clear width of exits. Such waiting areas shall be separated from the required exitways by substantial permanent partitions or by fixed rigid railings not less than 42 inches high.

816.10 Stairs and handrails.

- (a) See Subsection 806.3 for stairway riser and tread requirements.
- (b) For the purpose of this Section, riser height nonuniformity shall be limited to the extent necessitated by changes in the gradient of the adjoining seating area to maintain adequate sightlines. Where nonuniformities exceed $\frac{3}{8}$ inch between adjacent risers, the exact location of such nonuniformities shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the nonuniform risers. Such stripe shall be a minimum of 1 inch wide and a maximum of 2 inches wide.
- (c) Handrails at ramps shall comply with Subsection 807.4. Handrails at aisle stairways shall comply with Subsection 806.8(b), except where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches and not greater than 36 inches, measured horizontally, and the handrail shall have rounded terminations or bends. Where handrails are provided in the middle of aisle stairs, there shall be an additional intermediate handrail located approximately 12 inches below the main handrail.

Exception: Handrails for ramps or stairs required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.

**SECTION 817
SPECIAL EXIT REQUIREMENTS—
GROUP A-6 AND A-7 OCCUPANCIES**

817.1 Scope. In addition to the applicable requirements of Sections 801 to 816, Group A-6 and A-7 occupancies, including stadiums, reviewing stands, grandstands and bleachers constructed or erected in the District prior to and subsequent to the enactment of this Code, shall conform to the provisions of this Section and the *EPCOT Fire Prevention Code*.

817.2 Definitions.

- (a) **Exit.** Point of opening directly into a safe dispersal area of a public way. All measurements shall be made to that point when determining the distance of travel.
- (b) **Safe dispersal area.** An area that will accommodate a number of persons equal to the total capacity of the stadium, reviewing stand, grandstand or bleacher, and the building it is tributary to, in such a manner that no person within the area need be closer than 50 feet to the structure or the building. Dispersal areas shall have not less than 3 square feet per person.
- (c) **Stand.** A reviewing stand, grandstand or bleacher. [See Subsection 506.4(f).]

817.3 Height of stands. Grandstands and similar structures of combustible framing shall be not more than 11 rows or 9 feet high.

Exception: Open-air grandstands and bleachers of Type I, II or IV construction shall not be limited in height or area.

817.4 Spacing of seats.

- (a) The minimum spacing of rows of seats, measured from back to back, shall be as follows:

Seats without backrests in open-air stands	22 inches
Seats with backrests in open-air stands	30 inches
Chair seating	33 inches

There shall be a space of not less than 12 inches between the back of each seat and the front of the seat immediately behind it.

- (b) The maximum rise from one row of seats to the next row shall be not more than 16 inches.
- (c) For determining the seating capacity of a stand, the width of any seat shall be not less than 18 inches, nor more than 19 inches.
- (d) The maximum number of seats between any seat and an aisle shall be as follows:

Seats without backrests in open-air stands	15
Seats with backrests in open-air stands	9
Seats without backrests in buildings	9
Seats with backrests in buildings	6

817.5 Securing of chairs.

- (a) Chairs and benches used on raised stands shall be securely fastened to the platforms on which they are placed. When not more than 25 chairs are used on a single raised platform, the seats need not be fastened.

- (b) When more than 500 loose chairs are used in connection with outdoor athletic events, conventions or other gatherings, the chairs shall be fastened together in groups of not less than three.

817.6 Aisles.

- (a) Aisles shall be provided in all stands as required in Subsection 816.6.
- (b) Aisles may be omitted when all of the following conditions exist:
 1. Seats are without backrests.
 2. The rise from row to row does not exceed 12 inches.
 3. The number of rows does not exceed 11.
 4. The top seating board is not more than 10 feet above grade.
 5. The first seating board is not more than 20 inches above grade.
- (c) When an aisle is elevated more than 8 inches above grade, the aisle shall have a stairway or ramp, the width of which is not less than the width of the aisle.
- (d) No aisle shall have a dead end more than 16 rows deep regardless of the number of seats required.
- (e) Aisles shall be not less than 42 inches wide.

817.7 Stairs and ramps.

- (a) See Subsection 806.3 for stairway riser and tread requirements.
- (b) For the purpose of this Section, riser height nonuniformity shall be limited to the extent necessitated by changes in the gradient of the adjoining seating area to maintain adequate sightlines. Where nonuniformities exceed $\frac{3}{8}$ inch between adjacent risers, the exact location of such nonuniformities shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the nonuniform risers. Such strip shall be a minimum of 1 inch wide and a maximum of 2 inches wide.
- (c) Handrails at ramps shall comply with Subsection 807.4. Handrails at aisle stairways shall comply with Subsection 806.8(b), except where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches and not greater than 36 inches, measured horizontally, and the handrail shall have rounded terminations or bends. Where handrails are provided in the middle of aisle stairs, there shall be an additional intermediate handrail located approximately 12 inches below the main handrail.

Exception: Handrails for ramps or stairs required to be accessible shall comply with the *EPCOT Accessibility Code for Building Construction*.

- (d) The slope of a ramp shall be not more than 1 foot in 12 feet. Ramps shall be roughened or shall be of approved

nonslip material. A ramp with a slope of more than 1 foot in 20 feet shall have handrails, and stairways from stands shall have handrails conforming to the requirements of Subsection 902.2(h).

817.8 Guardrails.

- (a) Guardrails shall be required in all locations where the top of a seat plank is more than 4 feet above grade and the front of the stand is elevated more than 2 feet above grade. Guardrails shall be designed in accordance with Subsection 902.2(h).
- (b) Railings shall be 42 inches above the rear of the seat plank or 42 inches above the rear of the steps in an aisle when the guardrail is parallel to and adjacent to the aisle. The height may be reduced to 36 inches when the guardrail is located in front of the grandstand, except at the end of aisles.
- (c) When seats are at the extreme end or at the extreme rear of the bleacher or grandstand adjacent to the guardrail, two midrails shall be provided. The open space between the seat and the lower midrail shall be 10 inches maximum. The space between the guardrail and the lower midrail shall be bisected by the upper midrail.
- (d) Guardrails may be omitted when stands are placed directly against a wall or fence giving equal protection.

817.9 Handrails. Handrails at the front of stands and adjacent to an aisle shall be designed to resist a load of 50 pounds per lineal foot applied at the top rail.

817.10 Footboards. Footboards shall be provided for all rows of seats above the third row, or beginning where the seat plank is more than 2 feet above grade. Where the same level is used for both seats and footboards, and these levels are not less than 22 inches wide, footboards shall not be required.

817.11 Exits from stands.

- (a) **Distance to exit.** The line of travel to an exit from a stand shall be not more than 150 feet. For stands with seats without backrests, this distance may be measured by direct line from a seat to the exit from the stand.
- (b) **Aisle used as exit.** An aisle may be considered as only one exit, unless it is continuous at both ends to a required building exit or to a safe dispersal area.
- (c) **Two exits required.** Two exits shall be required for the following Group A-6 and A-7 occupancies.
 1. Every stand or section of a stand in a building with an occupant load of 50 or more.
 2. A stand with the first seat plank not more than 20 inches above grade or floor level may be considered to have two exits when the bottom of the stand is open at both ends.
 3. Every open-air stand with seats without backrests and with an occupant load of 300 or more.
- (d) **Three exits required.** Three exits shall be required for the following Group A-6 and A-7 occupancies.
 1. Stands within the building, and with an occupant load of 300 or more.

2. Open-air stands with seats without backrests and with an occupant load of 1,000 or more.
- (e) **Four exits required.** Four exits shall be required for the following Group A-6 and A-7 occupancies.
 1. Stand or sections of stands within the building, and with an occupant load of 1,000 or more.
 2. Open-air stands with seats without backrests, and with an occupant load of 3,000 or more.
- (f) **Determination of exit width.** The total width of exits, in feet, shall be not less than the total occupant load divided by 50, except as follows:
 1. For open-air stands with seats without backrests, the total width, in feet, shall be not less than the total occupant load served divided by 150, when stairways are used as exits, and 200 when horizontal exits or ramps are used.
 2. When both stairways and horizontal exits are used, the total width of exits shall be determined by using either 150 or 200, whichever is applicable.
- (g) **Minimum exit width.** Exits shall be not less than 42 inches wide.
- (h) **Exit arrangement.** Exits shall be placed a reasonable distance apart. When only two exits are provided, they shall be spaced not less than one-fifth of the perimeter apart.
- (i) **Exits from dispersal area.** Each safe dispersal area shall have at least two exits. When 6,000 or more persons are accommodated within a safe dispersal area, there shall be a minimum of three exits, and where 9,000 or more persons are accommodated, there shall be at least four exits. The aggregate clear width of exits from a safe dispersal area shall be determined on the basis of not less than 22 inches (one exit unit) for each 500 persons to be accommodated. The minimum width of the exit shall be 44 inches. Exits shall be located a reasonable distance apart but shall be spaced not less than one-fifth of the perimeter of the area from each other.
- (j) **Locking devices.** Requirements for panic hardware (see Section 814) may be waived on gates surrounding stadiums, when the gates are under constant supervision while the public is present, and when the safe dispersal areas are based on 3 square feet per occupant and are located between the stadium and the fence. The required dispersal area shall be located not less than 50 feet from the stadium.

SECTION 818 SPECIAL EXIT REQUIREMENTS— GROUP B OCCUPANCIES

818.1 Scope. Buildings housing Group B occupancies shall be provided with means of egress in accordance with the requirements of this Chapter and the special provisions in Subsections 818.2 and 818.3.

818.2 Group B, Division 3.

- (a) Where persons other than parking attendants are permitted to enter a Group B-3 occupancy, stairways and

exits shall meet the requirements of Sections 801 and 813 of this Chapter. The occupant load shall be based on 200 square feet per occupant. Where no persons other than parking attendants are permitted to enter, there shall be not less than two stairways, each 3 feet wide. Lifts may be installed for use of employees when meeting the requirements of EPCOT Standard 5-1.

- (b) Enclosure of vertical openings shall not be required, except as provided in Paragraph (a).

818.3 Group B, Division 4.

- (a) Exits and stairways from helistops shall comply with the provisions of Chapter 8, except that landing areas located on buildings or structures shall have two or more exits. For landing platforms or roof areas less than 60 feet long or less than 2,000 square feet in area, the second exit may be a fire escape or ladder leading to the floor below.
- (b) Enclosure of vertical openings shall not be required, except as provided in Paragraph (a).

SECTION 819 SPECIAL EXIT REQUIREMENTS— GROUP D OCCUPANCIES

819.1 Scope. Buildings housing Group D occupancies shall be provided with means of egress in accordance with the requirements of this Chapter and the special provisions in Subsections 819.2 through 819.7, and shall comply with the requirements of EPCOT Standard 5-2.

819.2 Separate access. Every room in a Group D occupancy shall have access to at least two approved means of egress from the building without passage through intervening rooms other than corridors or lobbies. All required exterior exit doors shall open in the direction of exit travel.

819.3 Minimum size of exits. Every opening through which patients are transported in wheelchairs, stretchers or beds shall be wide enough to permit the ready passage of such equipment, but shall be not less than 44 inches in clear width. Projections shall not be permitted within the 44-inch clear width.

819.4 Corridors.

- (a) The minimum clear width of all corridors in Group D occupancies shall be 44 inches, except corridors serving an area housing one or more nonambulatory patients, which shall be not less than 8 feet wide. Where there is a change of elevation, ramps shall be used and shall be constructed in accordance with Section 807. In jails, prisons, reformatories and other places of detention, where open, barred corridors are provided, corridors and cell doors are not required to be fire resistive.
- (b) Corridors in all Group D institutional occupancies shall be subdivided by smoke-protected partitions at intervals of not more than 150 feet. Doors in such partitions shall be tight fitting. Such doors may have wired glass panels of not more than 720 square inches.

Smoke-stop doors [see Subsection 805.8(a)] shall open in the direction of exit travel and shall have

approved door-holding devices of the type that releases the door, causing it to close when products of combustion other than heat are detected by a device complying with the requirements of EPCOT Standard 7-4.

819.5 Basement exits. One exit accessible to every room below grade shall lead directly to the exterior of the building at grade level.

819.6 Ramps. Every room in a Group D-1 occupancy housing bed patients shall have access to a horizontal exit or ramp leading directly to the exterior of the building at the ground-floor level.

819.7 Hardware.

- (a) Exit doors serving an occupant load of more than 50 shall not have latches or locks, except panic hardware.
- (b) Doors to patients' rooms and bathrooms shall be readily openable from either side without the use of a key or tool, or any special knowledge or effort.
- (c) No requirement of this Subsection shall prohibit cell-block construction in jails, or the use of locks or safety devices for forceful restraint of inmates.
- (d) In buildings housing occupancies in which the personal liberties of inmates or patients are restrained within the building, and which are constructed in conformance to the special provisions of Section 509, the exterior doors may be fastened with locks, provided that room doors shall not be fastened except by doorknob latches or similar devices, and can be opened readily from the corridor side without the use of a key or tool, or any special knowledge or effort.

**SECTION 820
SPECIAL EXIT REQUIREMENTS—
GROUP E OCCUPANCIES**

820.1 Scope. Buildings housing Group E occupancies shall be provided with ways of departure in accordance with the requirements of this Chapter and the special provisions of Subsections 820.2 through 820.8.

820.2 Corridors and exterior exit balconies.

- (a) The width of corridors and exterior exit balconies in Group E occupancies shall be as required in Section 805, but not less than 6 feet.

Exception: When the occupant load served is less than 100, the corridor may be 44 inches wide.

- (b) Corridor walls and ceilings shall be of not less than 1-hour fire-resistive construction with openings protected as required in Subsection 510.7, except when each instructional room has at least one ground-level exit and when assembly rooms have at least one-half of the required exits direct to the exterior at ground level.
- (c) Ramps shall be used where there is a change of elevation of less than 2 feet in a corridor or exterior exit balcony.

820.3 Exits direct to the exterior.

- (a) Every room in a Group E-1 occupancy shall have an exit direct to the exterior of the building or to an exterior exit balcony.

In lieu of this requirement, corridors, stairways, storage rooms, laboratories and administrative areas shall be protected with an approved automatic fire-extinguishing system that shall be connected to the school fire alarm system.

- (b) Classrooms having openable windows not more than 36 inches above the floor and not more than 6 feet above the adjacent ground level, usable for emergency exit, need not have exits that lead directly to the exterior, nor need they be provided with an approved automatic fire-extinguishing system, unless such system is required by other provisions of this Code.

820.4 Exits serving school auditoriums. Where an auditorium is not used at the same time as other rooms in the building, an exit serving both the auditorium and the other rooms shall comply with the requirements for width calculated for the largest occupant load.

820.5 Stairways. Each floor above or below the ground floor shall have not less than two exit stairways. The required exit width shall be divided equally between such stairways, but no stairway serving an occupant load of more than 100 shall be less than 5 feet in clear width.

820.6 Exit doors.

- (a) The width of exit doors from corridors, halls and stairways shall be sufficient to accommodate the occupant load served.
- (b) Exit doors in classrooms having an occupant load of more than 50 shall swing in the direction of travel.

820.7 Rooms below grade.

- (a) At least one exit accessible to every room below grade shall lead directly to the exterior of the building at grade level.
- (b) Classrooms located in basements shall have one exit opening directly to the exterior of the building from each room.

820.8 Fences and gates. School grounds may be fenced in and gates may be equipped with locks, provided that safe dispersal areas located not less than 50 feet from the buildings are available for escape of persons from the area between buildings and fence. Size of dispersal areas shall be based on an area of not less than 3 square feet per occupant. Gates that comply with exit requirements for dispersal areas in Subsection 817.11, may be permitted across corridors or passageways leading to such dispersal areas.

**SECTION 821
SPECIAL EXIT REQUIREMENTS—
GROUP H OCCUPANCIES**

821.1 Scope. Buildings housing Group H occupancies shall be provided with means of egress in accordance with the requirements of this Chapter and the special provisions of Subsection 821.2.

821.2 Exits required.

- (a) Every part of a Group H occupancy having a floor area of 200 square feet or more shall be served by at least two separate exits.

- (b) In Group H, Division 1 and 2 occupancies, no part of any room shall be more than 75 feet from an exit door.
- (c) Doors leading to a corridor of fire-resistive construction shall have a $\frac{3}{4}$ -hour fire protection rating and shall have not more than 100 square inches of wired glass set in steel frame, shall be maintained self-closing or shall be automatic closing as required by Subsection 704.3 and shall open in the direction of exit travel.

SECTION 822 SPECIAL EXIT REQUIREMENTS— GROUP R OCCUPANCIES

822.1 Scope. Buildings housing Group R occupancies shall be provided with means of egress in accordance with the requirements of this Chapter and with the special provisions in Subsections 822.2 to 822.5.

822.2 Two exits required. Rooms, suites of rooms or floor space above the ground floor shall have access to not less than two independent exits. Exit or exit access doors shall be arranged in accordance with Subsection 803.3.

822.3 Travel distance within a guest room or dwelling unit. In buildings more than one story in height housing Group R, Division 1 and 2 occupancies, the maximum distance of the path of egress travel shall not exceed 50 feet from any point within a guest room or dwelling unit.

822.4 Exit and exit access doors.

- (a) In Group R, Division 1 and 2 occupancies, each independent room, or each suite or apartment shall have at least one exit or exit access door of the swing-type opening into a public corridor or hallway.
- (b) Doors opening from guest rooms to public corridors shall be protected as required in Subsection 805.8.
- (c) Doors opening from a public hall, or from another public space into a bedroom suite or rooms, or an apartment shall be equipped with a substantial lock.
- (d) There shall be one or more exit or exit access doors for dormitories with less than 450 square feet of floor space. Rooms with an area of 450 square feet or more shall have two exit or exit access doors located in accordance with Subsection 801.3.

822.5 Emergency escape and rescue openings for Group R occupancies. In all Group R occupancies, sleeping rooms below the fourth floor of a building shall have at least one openable window or exterior door to permit emergency escape or rescue. Where windows are provided, they shall have a sill height of not more than 44 inches above the floor. Windows having not less than 5.7 square feet of openable area with a clear opening height not less than 24 inches and a clear opening width not less than 20 inches shall be considered to meet the requirements of this Subsection. The door or window shall have direct access to a street, public space, yard or court, or to an exterior exit balcony that opens to a street, public space, yard or court.

Exception: Doors meeting Subsection 822.4.

822.6 Stairways.

- (a) In buildings of not more than five stories with balconies or verandas, where each room, suite or apartment opens direct to the balcony or veranda, required stairways may extend from ground level to the fifth floor on the outside. No window, door or other opening shall be less than 10 feet from any part of the stairway; except that all doors or window openings less than 10 feet from the exit stairway shall be of approved construction and shall have a $\frac{3}{4}$ -hour fire rating. Such doors shall be self-closing and protection from the elements shall be provided as required by the Building Official. Balconies and verandas include galleries, all of which shall be roofed.
- (b) Required exterior stairways of buildings of three stories or more shall be roofed.
- (c) All interior stairways shall have solid risers, except that interior stairways within individual units may have open risers when they are of noncombustible construction or have a 1-hour fire-resistive rating. Exterior stairways may have open risers. A nosing shall overlap any open riser by not less than 1 inch, nor more than 2 inches.
- (d) All openings within 10 feet of exterior stairways or fire escapes shall be protected with approved self-closing fire doors or approved fire windows.
- (e) Exterior stairways, unless required to be enclosed with noncombustible materials in accordance with other provisions of this Code, shall be provided with metal mesh or other rigid guards at least 3 feet high on each unenclosed side of the stairway from any point of tread or railing. All glass used in the construction of such enclosures shall be wired glass.

CHAPTER 9

DESIGN REQUIREMENTS

SECTION 901 GENERAL LOAD REQUIREMENTS

901.1 Definitions. For the purpose of this Chapter, certain terms are defined as follows:

- (a) **Collateral load.** The dead load in a pre-engineered building, which is over and above the weight of the pre-engineered building system.
- (b) **Dead load.** The dead load of a building shall include the weight of the walls, permanent partitions, framing, floors, roofs and all other permanent stationary construction entering into and becoming a part of a building.
- (c) **Live load.** The live load includes all loads except dead and lateral loads.
- (d) **Partition loading.** A dead load that is added to the dead loading (and not to be reduced by live load reduction) where partitions may be erected or rearranged. [See Subsection 902.2(b).]

901.2 Loads. Buildings and all parts thereof shall be of sufficient strength to support estimated or actual imposed loads in addition to their own dead load without exceeding the stresses set forth in this Code, but no building or part thereof shall be designed for loads less than those specified in this Chapter.

901.3 Design.

- (a) Any system or method of construction to be used shall permit a rational analysis in accordance with well established principles of mechanics.
- (b) Permitted stresses and soil-bearing values specified in this Code for working stress design may be increased one-third when considering wind forces either acting alone or when combined with vertical loads. No increase will be allowed for vertical loads acting alone.
- (c) Load factors for ultimate strength design of concrete and plastic design of steel, and load and resistance factor design of steel shall be as specified in Chapter 10, regulations for use of the materials of construction.
- (d) Load combinations on buildings and other structures shall be determined in accordance with EPCOT Standard 9-7, Section 2. Under stated load combinations, increases in allowable stresses of materials shall not be permitted, except that a load duration factor in EPCOT Standard 1010-1 shall be allowed. The effect of the most unfavorable combinations of loads and conditions of loading affecting the design shall be taken into account, except as otherwise provided herein. Crane hook loads need not be combined with the roof live load or with more than three-fourths of the snow load or one-half of the wind load. Buoyancy in the design for uplift shall use the water table at the top of the ground unless a positive method is provided to lower it.

- (e) The dead loads used in the design shall not be less than the actual dead load of construction and shall not be less than the dead loads listed in Appendix P unless specifically approved by the Building Official.
- (f) The design dead load, live load and wind load for all parts of the structure shall be shown on the structural plan. All applicable special loads shall also be indicated.
- (g) In structural design, due allowance shall be made for any material to be removed for the installation of pipes, conduits or other equipment.
- (h) Gypsum shall not be used for shear walls or for horizontal diaphragms.
- (i) Stresses caused by temperature, creep, shrinkage, moisture and/or differential foundation settlement shall be considered in the design.
- (j) The design of structural systems shall include weight of service equipment (heating, ventilation and air conditioning; fire protection; plumbing stacks and risers; and electrical feeders) at roof and floor levels.

901.4 Deflection.

- (a) The deflection of a structural member shall not exceed the value set forth in Table 9.1; criteria representing the most restrictive condition shall apply. Deflection criteria for materials not specified shall be developed in a manner consistent with the provisions of this Subsection.
- (b) All roofs shall be designed with sufficient slope or camber to assure adequate drainage after the dead load deflection due to initial set and long time deformation has taken place, except that roofs may be constructed level if the dead load deflection pockets due to initial set and long time deformation are not over $\frac{1}{2}$ inch deep below the drainage invert and at no point deflect more than $\frac{1}{2}$ inch for a 5-pound-per-square-foot (psf) live load on all or alternate spans. Cantilever members drained at the unsupported end need not meet the deflection requirements.

Roofs with a slope of less than $\frac{1}{4}$ inch per foot shall be designed to prevent instability from ponding loads.
- (c) Deflection of tall buildings or structures shall be limited to a maximum of $h/500$ (h = height) unless specifically permitted by the Building Official.

901.5 Load tests. Where there is reason to doubt the safety of any structural part of a building or structure in the course of construction or before a certificate of occupancy has been issued, the Building Official may require recognized standard load tests or other approved tests to determine the acceptability of the construction. Such tests shall be made under the direction of a Professional Engineer registered in the State of Florida and shall be approved by the Building Official.

DESIGN REQUIREMENTS

TABLE 9.1^{b, c, d, e, f}
MAXIMUM DEFLECTION FOR STRUCTURAL MEMBERS

TYPE OF MEMBER	MEMBER LOADED WITH LL ONLY	MEMBER LOADED WITH LL AND K•DL
Roof member or floor member supporting plaster or comparable brittle finish	$L/360$	$L/240$
Roof or floor member with flexible or no finish	Not applicable	$L/150$

- a. For K , see Table 9.2.
b. Maximum deflection for formed metal sheets
 For structural roofing without covering..... $L/60$
 For wall siding..... $L/60$
c. Maximum deflection for secondary members supporting formed metal sheets:
 For roof..... $L/150$
 For wall..... $L/90$
d. For concrete structural members, see EPCOT Standard 1003-1.
e. For steel structural members, see EPCOT Standards 1009-1, 1009-3 and 1009-4.
f. For masonry structural members, see EPCOT Standards 1006-1 and 1006-2.

TABLE 9.2
VALUE OF K

WOOD		STEEL
Unseasoned 1.0	Seasoned ^a 0.5	0

- a. Seasoned lumber is lumber having a moisture content of less than 16 percent at the time of installation and used under dry conditions of use, such as in most covered structures.

901.6 Anchorage.

- (a) Walls shall be anchored to floors and roofs that provide lateral support for the wall or are required to provide stability for the wall. Such anchorage shall be capable of resisting the horizontal forces specified in this Chapter. Required anchors in masonry walls of hollow units or cavity walls shall enter a grouted structural element of the wall.
(b) Lintels, joists, beams, girders or trusses shall be anchored to their supports.

SECTION 902 UNIT LIVE LOADS

902.1 Unit live loads. The unit live loads set forth in Table 9.3 shall be taken as the minimum live loads, in pounds per square foot (psf) of horizontal projection, to be used in the design of buildings for the occupancies listed; and loads, at least equal, shall be assumed for uses not listed in this Subsection, but which create or accommodate similar loadings.

902.2 Special loads. The following special loads shall be considered in the design of buildings and structures:

- (a) **Offices.** Provisions shall be made in designing office floors for a load of 2,000 pounds placed upon an otherwise unloaded space $2\frac{1}{2}$ feet square.
(b) **Partitions.** In parts of buildings used for offices, and other building occupancies, such as hotels, motels, condominiums, etc., where partitions could be erected or rearranged, provisions shall be made for a minimum partition dead-load weight, whether or not partitions are shown on the plans, known as partition dead

loading, except where the design live load is 100 psf or more. The partition loading shall be:

1. Masonry walls = 20 psf.
2. Metal or wood studs with gypsum board = 10 psf.
3. Lightweight office partitions 6 feet or less = none (included in the floor live load).

In hotels, motels, condominiums, etc., where tenant separation is by structural load-bearing masonry walls, no partition loading is required. (Gypsum tenant separation walls require a design load for partition loading.)

- (c) **Interior partitions.** Interior walls and permanent or temporary partitions more than 6 feet high shall be designed to resist all loads to which they are subjected, but not less than 5 psf applied perpendicular to the walls. The deflection of such walls shall not be more than $\frac{1}{240}$ of the span for walls with plaster or comparable brittle finishes, and $\frac{1}{120}$ of the span for walls with flexible finishes.

(d) **Veneer.**

1. Veneer, exterior and interior, shall support no load other than its own weight and the vertical dead load of the sections of veneer above. Surfaces to which veneer is attached shall be designed to support the additional vertical and lateral loads imposed by the veneer. Consideration shall be given for differential movement of supports, including that caused by temperature changes, shrinkage, creep and deflection.
2. Adhered veneer and its backing shall be designed to have a bond to supporting element sufficient to withstand a shearing stress of 50 pounds per square inch (psi). Anchored veneer and its attachments shall be designed to resist a horizontal force equal to twice the weight of the veneer.

- (e) **Stage floors.** Stage floors shall be designed to support not less than 125 psf, a 2,000-pound concentrated load on a 1-square-foot area, at any point, and shall comply with the requirements of Appendix G.

- (f) **Gridirons and fly galleries.** Gridirons and fly galleries shall be designed in accordance with Subsection G-201.3.

- (g) **Reviewing stands.** The minimum unit live load for reviewing stands, grandstands and bleachers shall be 100 psf of the horizontal projection from the structure as a whole. Seat and footboards shall be designed to resist 120 pounds per lineal foot. Lateral sway bracing loads of 24 pounds per foot parallel and 10 pounds per foot perpendicular to seats and footboards shall be used.

(h) **Railings.**

1. Handrails and guardrails in front of reviewing stands shall be designed to resist a horizontal force of 50 pounds per lineal foot, applied in any direction at the top of the railing. Railings shall also, but not necessarily simultaneously, withstand a minimum 200-pound concentrated load applied in any direction, at any point on the handrail or top rail, to produce the maximum load effect on the element being considered.

2. Intermediate rails (all those except the handrail), balusters, and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot, including openings and space between rails.

Reactions due to this loading are not required to be superimposed with those of Subsection 902.2(h)1.

Exception: All handrails, grab bars and tub and shower seats shall comply with the concentrated load requirements of the *EPCOT Accessibility Code for Building Construction*.

- (i) **Truck loads.** Floor systems in public garages and commercial or industrial buildings in which loaded trucks are placed, used or stored, shall be designed to support a concentrated rear wheel load of a loaded truck placed in any position.
- (j) **Passenger cars.** Floor systems in garages used for storage of private passenger cars shall be designed for a concentrated wheel load of not less than 2,000 pounds.

TABLE 9.3
MINIMUM LIVE LOADS

PROJECTION ^a	LIVE LOAD, in psf, OF HORIZONTAL TYPE OF LOAD
Apartments	40
Armories	150
Auditorium—fixed seats	50
Auditorium—movable seats	100
Balconies and galleries—fixed seats	50
Cornices	60
Corridors, public	100
Dance halls	100
Drill rooms	100
Dwellings	40
Exterior balconies—R-3 occupancy	60
Exterior balconies—all except R-3 occupancy	100
Fire escapes	100
Garages—storage or repairs	100
Garages—private pleasure cars	50
Gymnasiums	100
Hospitals—wards and rooms	40
Hotels—guest rooms and private corridors	40
Libraries—reading rooms	60
Libraries—stack rooms	125
Loft buildings	100
Manufacturing—light	75
Manufacturing—heavy	125
Marquees	60
Offices	50
Printing plants—press rooms	150
Printing plants—composing and linotype rooms	100
Public rooms	100
Restrooms	50
Reviewing stands and bleachers	100
Roof loads	20
Schools—classrooms	40

(continued)

TABLE 9.3—continued
MINIMUM LIVE LOADS

PROJECTION ^a	LIVE LOAD, in psf, OF HORIZONTAL TYPE OF LOAD
Sidewalks	250
Skating rinks	100
Stage floors	125
Stairways	100
Storage—light	125
Storage—heavy not less than (to be determined by occupancy)	250
Stores—retail, light merchandise	75
Stores—wholesale, light merchandise	100
Unbalanced live load—See Subsection 903.2	12

a. Except as regulated by Sections and Subsections of this Chapter.

- (k) **Catwalks.** Catwalks and supports shall be designed for either 50 psf uniform load or a 500-pound concentrated load at any point, whichever results in higher stresses. Catwalk live load need not be considered simultaneously with any other live loads.
- (l) **Sidewalks.** For sidewalks over vaults, areaways and similar structures, the live load shall be 250 psf uniformly distributed; or, where such sidewalks are subject to trucking, they shall be capable of safely sustaining a concentrated load of 8,000 pounds placed on any space 2½ feet square where this load results in higher stresses.
- (m) **Metal or pre-engineered buildings.** The buildings shall be designed to have a minimum of 10 psf collateral load. The frame (purlins and girts are excluded) shall be capable of carrying a minimum 1,000-pound concentrated load at any point (not simultaneously with other live loads).
- (n) **Canvas awning frames.** The frames shall be designed to carry a minimum 500-pound concentrated load at any point. Wind load is required, but no live load is required.
- (o) **Metal awnings and canopies.** Awnings and canopies shall be designed to carry a minimum of 10 psf live load, horizontal dead load and horizontal wind load simultaneously. Also, the design shall carry a minimum of a 300-pound concentrated load on an area 1 foot by 1 foot at any point on the roof surface (including the edge not simultaneous with other loads), the dead load and a 10-psf live load.
- (p) **Concentrated floor live loads.** All probable concentrated loads shall be considered. In the design of floors, where such loads may occur, the supporting beams, girders and slabs shall be designed to carry either the concentrated loads or the uniform live loads required, whichever produces the greater stresses.
- (q) **Fire sprinkler systems.** The standard for the installation of sprinkler systems, NFPA 13, shall be the minimum for supporting sprinkler systems. The following shall also apply:

1. The sway bracing shall be adequate to prevent movement.

DESIGN REQUIREMENTS

2. The building must be able to support the hanger load of the pipe, plus water, plus 250 pounds. The hanging system must be able to support five times the pipe plus water, then add 250 pounds.
3. Risers shall be supported.
4. Risers in vertical shafts or in buildings with ceilings more than 25 feet shall have a minimum of one support for each pipe section.

- (r) **Gymnasium, main floors and balconies.** In addition to vertical loads, main floors and balconies with bleachers shall be designed to resist a horizontal swaying force of 24 pounds per linear foot of seats in the direction parallel to the seats, and of 10 pounds per linear foot of seats in the or a direction perpendicular to the length of the seats.

902.3 Heliports and helistops. In addition to other design requirements of this Chapter, heliport and helistop landing areas shall be designed for the maximum stress induced by the following loads:

- (a) Dead load plus actual weight of the helicopter.
- (b) Dead load plus a single concentrated impact load covering 1 square foot, of 0.75 times the fully loaded weight of the helicopter if it is equipped with hydraulic-type shock absorbers, or 1.5 times the fully loaded weight of the helicopter if it is equipped with a rigid or skid-type landing gear.
- (c) The dead load plus a uniform live load of 100 psf. The required live load may be reduced according to the formula in Subsection 902.4(a).

902.4 Live load reduction.

- (a) For occupancy live loads of 100 psf or less, the design live load on any member supporting a floor area of 150 square feet or more may be reduced in accordance with the method resulting in the least percentage, as follows:
 1. By applying the formula $R = [A - 150] 0.08\%$
 2. By applying the formula $R = 100 \frac{(D + L)}{4.33L}$

Where:

R = Reduction, in percent.

D = Dead load per square foot of area supported by member.

A = Area, in square feet, supported by the member.

L = Design live load per square foot of area supported by member.

The reduction shall not exceed 40 percent for members receiving loads from one level only or 60 percent for other members except as set forth in Paragraph (d).

- (b) Where a member supports floors of more than one story, reduction of the design live load on the member by Method 1 in Paragraph (a) shall be made for floors taken one story at a time, starting with the uppermost floor supported by the member.

- (c) For live loads of 100 psf or less, no reduction shall be made for areas occupied as places of public assembly.
- (d) The reduction in live load on floors for storage of private passenger cars shall be in accordance with the requirements of Paragraph (a), but shall not be more than 40 percent.
- (e) There shall be no reduction for live load on the roof in any members.

Exception: Pre-engineered buildings with a collateral load of 10 psf or greater may use the following roof live loads:

ROOF SLOPE	AREAS		
	0 – 200	201 – 600	OVER 600
Less than 4 in 12	20	16	12
4 in 12 to less than 12 in 12	16	14	12
12 in 12 or greater	12	12	12

902.5 Impact loads. The live loads given in this Section include allowance for ordinary impact conditions; however, where uses or loads produce unusual vibrations or impact force, provision shall be made in the structural design for such forces in accordance with the following:

- (a) All moving elevator loads shall be increased 100 percent for impact.
- (b) For the purpose of design, the weight of heavy machinery and moving loads shall be increased as set forth herein to allow for impact: (1) elevator machinery, 100 percent; (2) light machinery, shaft- or motor-driven, 20 percent; reciprocating machinery or power-driven units, 50 percent; and hangers for floor and balconies, 33 percent. All percentages shall be increased where specified by the manufacturer.
- (c) All craneways shall be designed to resist a horizontal transverse force equal to 20 percent of the sum of the crane capacity and the weight of the trolley; one-half of the force to be applied at the top of the runway rail. In addition, all craneways shall be designed to resist horizontal longitudinal force equal to 10 percent of the total of the maximum wheel loads applied at the top of each rail.
- (d) Where moving loads not specified within this Subsection are concerned, the impact load shall be determined by a method satisfactory to the Building Official.
- (e) Hand hoists and monorail hoists shall have the loadings increased 25 percent for impact.

902.6 Retained material loads. Retaining walls shall be designed to resist the lateral pressure of the retained material. Cantilever walls not more than 15 feet high retaining level drained earth may be designed for pressure equivalent to that exerted by a fluid weighing not less than 30 pounds per cubic foot and having a depth equal to that of the retained earth. Any surcharge shall be in addition to the equivalent fluid pressure.

Retaining walls shall be designed to resist sliding and overturning with a minimum factor of safety of 1.5 in each case.

902.7 Posting live loads.

- (a) In buildings, structures or parts thereof, used for business, mercantile, industrial or storage occupancies, the live load for which each floor or part is designed and approved shall be conspicuously posted, using durable metal signs in that part of the story to which it applies. It shall be unlawful to remove or deface such signs.
- (b) No person shall place or cause to be placed on the floor or roof of a building or structure a heavier load than that for which the floor or roof is designed and approved.

902.8 Hydrostatic uplift. All structural components subject to hydrostatic uplift shall be designed to resist the uplift force with a minimum factor of 1.5.

SECTION 903 ROOF LOADS

903.1 Unit live load. Roofs shall be designed for unit live loads not less than those set forth in Table 9.3, applied vertically to the horizontal projection of the surface.

903.2 Special loading.

- (a) Unbalanced loading shall be applied where such loading will require larger members or connections. Trusses and arches shall be designed to resist the stresses caused by unbalanced unit live loads on one-half of the span, when such loading results in reversal of stresses or in higher stresses in any part of the roof than the stresses produced by the required unit live load on the entire span. Roofs whose structure is composed of a stressed shell, framed or solid, wherein stresses caused by a point loading are distributed throughout the area of the shell, the requirements for unbalanced unit live load design may be reduced 50 percent.
- (b) Scuttles and ribs of skylights shall be designed to support a vertical concentrated load of 300 pounds placed anywhere or the loadings specified in Section 902.
- (c) Greenhouses shall be designed for the following:
 1. Live load on film-type, nonrigid greenhouse roofs, 10 psf
 2. Live load on glass or rigid plastic greenhouse roofs, 15 psf
 3. Dead load – allowance for piping, electrical, etc., 10 psf + structure weight
 4. Crop load on structures shall be stated on drawings.

903.3 Roof drainage.

- (a) Except where a roof is sloped to drain over roof edges or is designed to support accumulated water, roof drains shall be installed at each low point of the roof. Roof drains shall be large enough to convey the tributary water to the roof drainage system.
- (b) Where roof drains are required, overflow scuppers having open areas three times the size of roof drains shall be installed in adjacent parapet walls with the inlet flow line located 2 inches above the low point of

the adjacent roof and having a minimum opening height of 4 inches. When permitted by the Building Official, overflow drains of the same size as the roof drains may be installed with the inlet flow line located 2 inches above the low point of the roof. Overflow drains connected to the drain line shall be independent from the roof drains from the overflow inlet to the overflow discharge.

- (c) Roof drains and overflow drains, when concealed within the construction of the building, shall be installed in accordance with the *EPCOT Plumbing Code*.

SECTION 904 WIND LOADS

904.1 Design for wind loads required.

- (a) Buildings and structures, and every part thereof, shall be designed to withstand the forces of wind pressure assumed in any direction. No allowance shall be made for the effect of shielding by other structures. Wind pressures shall be assumed to act normal to the surface considered.

Exception: Fences 6 feet or less in height associated with Group R-3 occupancies are not required to withstand the forces of wind.

- (b) The floor, roof or other horizontal bracing system shall be designed and constructed to transfer horizontal forces to the parts of the structural frame designed to carry the forces to the ground. Where horizontal- or vertical- shear-resisting elements are designed to transfer forces through the diaphragm action, the analysis shall include the design of chord members at or near the extremities of the diaphragm and the method by which the forces are transferred to the resisting elements. The total shear in any horizontal plane shall be distributed to the various elements of the lateral-force-resisting system in proportion to their rigidities, taking into consideration the rigidity of the horizontal bracing system or diaphragm.
- (c) Roofing assemblies (material) shall comply with the requirements of EPCOT Standard 9-7 and FM 4450, FM 4470, UL 580, UL 1897 or ASTM E1592.
- (d) The drawings shall show the following information for wind loads:
 1. Basic wind speed (3-second gust), miles per hour.
 2. Wind importance factor, I , and occupancy category.
 3. Wind exposure, if more than one wind exposure is used, show each wind exposure and its applicable wind direction.
 4. Internal pressure coefficient.
 5. Wind design pressure to be used for the design of components and claddings; if more than one wind exposure is used, show wind design pressure for each exposure.
 6. Wind directionality factor, K_d .

904.2 Determination of wind loads.

- (a) Wind loads on buildings and other structures shall be determined in accordance with EPCOT Standard 9-7, 9-8 or 9-9 in Appendix A. The Ultimate Design Wind Speed shall be 129 mph (Risk Category I), 139 mph (Risk Category II) and 149 mph (Risk Category III and IV). The Building Official may require evidence to support design pressures used in the design of structures not included in this Section. For buildings or structures with unusual geometry, or subjected to unusual wind responses, the Building Official may require wind tunnel tests or additional nationally recognized data.
- (b) **Wind loads during construction.** Wind loads on structural components and assemblages during erection and construction shall be considered.
- (c) **Wind loads on rooftop equipment.** Rooftop equipment, ductwork and related supporting structures shall be designed for wind load without reduction due to shielding effect by parapet walls or other structures.
- (d) For each wind direction considered, a wind exposure category that adequately reflects the site terrain in accordance with Section 6.5.6 of EPCOT Standard 9-7 shall be provided.
- (e) Ultimate design wind speed used for determining wind loads on temporary structures shall be 94 mph.

904.3 Stability.

- (a) Calculations to determine overturning and the uplift and sliding forces shall be made with provisions set forth in Subsection 904.2(a).
- (b) The overturning moment calculated from the wind pressure shall not exceed two-thirds of the resisting dead load moment unless additional anchorage for excess moment is provided.
- (c) The uplift forces calculated from the wind pressure shall not exceed two-thirds of the resisting dead loads unless additional anchorage for excess uplift is provided.
- (d) The base shear calculated from the wind load shall not exceed two-thirds of the total resisting force due to friction or other factors unless additional anchorage for the excess base shear is provided.
- (e) Anchorage of the roof to walls and columns, and of walls and columns to the foundation to resist overturning, uplift and sliding forces shall be provided. If dead load is used as part of the resistance, the minimum dead load that is likely to remain in place during design wind event shall be used.

SECTION 905 EXCAVATIONS

905.1 Scope.

- (a) The provisions of this Section shall apply to excavations for buildings and structures for which permits are issued by the Building Official. Excavation, grading

and fill operations for which a separate permit is required, or where hazardous conditions exist, or where the cut slope is steeper than two horizontal to one vertical shall be performed under the direction of a Professional Engineer registered in the State of Florida.

- (b) The quality and design of the materials used in foundations, footings and retaining walls shall conform to the requirements of Chapter 10 and to the applicable EPCOT Standard as listed in Appendix A for Chapters 9 and 10.

905.2 Protection of excavations. Until provisions for permanent supports have been made, excavations shall be guarded and protected to prevent them from becoming dangerous to life and property. Excavations, other than minor excavations approved by the Building Official, shall not extend within 1 foot of any plane projecting at an angle of 30 degrees from the horizontal from the bottom of a soil-bearing foundation, unless such footing or foundation is protected against settlement.

905.3 Permanent excavations.

- (a) No permanent excavations shall be made, nor shall construction excavations be left open that will endanger adjoining property or buildings or that will be a menace to public health or safety. Such excavations shall be well drained and the drainage shall function as long as the excavation exists.
- (b) Permanent excavations shall have retaining walls of steel, masonry, concrete or similar approved material of sufficient strength to retain the embankment and any surcharge loads or the embankment shall have safe side slopes as determined by the Building Official.

905.4 Fill.

- (a) All fills shall be compacted to a minimum of 90 percent of maximum density, as determined by laboratory test in accordance with EPCOT Standard 9-2 or as approved by the Building Official.
- (b) The natural ground surface shall be prepared to receive fill by removing vegetation, noncomplying fill and top soil.
- (c) No organic material shall be permitted in fills, and no rock or similar irreducible material larger than 8 inches in one dimension shall be placed in a fill.
- (d) No compacted fill shall be made that would create an exposed surface steeper in slope than two horizontal to one vertical. The Building Official may require that the fill be constructed with an exposed surface flatter than two horizontal to one vertical if he finds this slope necessary for stability and safety.

905.5 Unsafe excavations. Where, in the opinion of the Building Official, an unsafe condition may result or damage may occur as the result of an excavation, he may order the work stopped in accordance with Subsection 104.6, or he may approve the work of excavation subject to such limitations as he may impose.

SECTION 906 BEARING CAPACITY OF SOIL

906.1 Classification. As required by the Building Official, classification of the soil under all parts of every building shall be based on examination of test borings or excavations made at the site. Location of the test borings or excavations and the nature of the subsurface materials shall be indicated on the plans.

906.2 Soil investigation. Where the bearing capacity of the soil is not definitely known or is doubtful, or where the load imposed on the soil is unusual, the Building Official may require load tests or examination and evaluation of subsoil conditions by a Professional Engineer registered in the State of Florida. To determine the permitted safe bearing capacity, the soil may be tested by loading an area not less than 2 square feet to not less than twice the maximum bearing capacity desired for use. Such load shall be sustained by the soil until no additional settlement takes place for a period of not less than 48 hours, so that such desired bearing capacity may be used. Examination of subsoil conditions may be required when believed to be necessary by the Building Official.

Exception: A soil investigation report is not required for temporary structures installed on compacted asphalt.

906.3 Presumptive capacities. Where no unusual soil or moist conditions are present, the permitted bearing capacities on supporting soils shall not exceed those set forth in Tables 9.10 and 9.11, unless the design-bearing capacity is substantiated by recognized tests, analysis and procedure as required by the Building Official.

**TABLE 9.10
MAXIMUM SOIL PRESSURES**

CLASS OF MATERIAL	MINIMUM DEPTH OF FOOTING BELOW ADJACENT GROUND (feet)	VALUE PERMITTED IF FOOTING IS AT MINIMUM DEPTH (psf)	INCREASE IN VALUE FOR EACH FOOT OF DEPTH THAT FOOTING IS BELOW MINIMUM DEPTH (psf) ^a	MAXIMUM VALUE (psf) ^a
Compact fine sand	1	1,000 ^b	200 ^b	5,000
Loose sand	2	500 ^b	100 ^b	3,000
Medium stiff clay or sandy clay	1	2,000	200	6,000
Soft sandy clay or clay	2	1,000	50	2,000
Compact inorganic sand and silt mixtures	1	1,000	200	4,000
Loose inorganic sand and silt mixtures	2	500	100	1,000
Loose organic sand and silt mixtures and peat	0	0	0	0

a. These values are considered sufficient to prevent failure of the supporting ground, but not to prevent excessive foundation movement or settlement where unusual soil or moisture conditions are encountered.

b. Values for footings 1 foot wide and may be increased in direct proportion to the width of the footing to a maximum of 2^{1/2} times the designed value.

**TABLE 9.11
MAXIMUM LATERAL SOIL PRESSURE**

CLASS OF MATERIAL	PERMITTED VALUES ^a PER FOOT OF DEPTH BELOW NATURAL GRADE ^b (psf)	MAXIMUM PERMITTED VALUES ^a (psf)
Compact fine sand Medium clay Compact sandy loam Loose coarse sand and gravel	200	2,500
Soft clay Clay loam Poorly compacted sand Clays containing large amounts of silt	100	1,500

a. These values are considered sufficient to prevent failure of the supporting ground, but not to prevent excessive foundation movement or settlement where unusual soil or moisture conditions are encountered.

b. Isolated poles, such as flagpoles or signs, may be designed using lateral bearing valued equal to two times tabulated values.

SECTION 907 SOIL-BEARING FOUNDATIONS

907.1 General provisions.

- Footings shall be designed to minimize differential settlement.
- Excavations for continuous footings shall be cut true to line and grade, and the sides of footings shall be formed, except where soil conditions are such that the sides of the excavation stand firm and square. Where earth is the side form, then the sides of the footing shall be a minimum of 1 inch outside of the required dimension line. Excavations shall be made to firm, clean bearing soil.
- Foundations for all buildings shall be level or shall be stepped so that both the top and bottom of the foundation are level. At steps, the foundation shall have a vertical tie of the same cross section and design as the footings or the smaller of the footings so joined. The maximum step shall be 18 inches and the minimum run between steps shall be 36 inches.

907.2 Design using lateral bearing. Construction using posts or poles as cantilever columns embedded in concrete footings in the earth may be used to resist both axial and lateral loads. The depth to resist lateral loads shall be determined by use of the design criteria established in Subsection 907.3 or by other methods approved by the Building Official.

907.3 Design formula—no constraint. The following formula may be used in determining the depth of embedment required to resist lateral loads where no constraint is provided at the ground surface, such as rigid floor or ground surface pavement:

$$D = (A/2) (1 + B)$$

Where:

$$A = \frac{2.34P}{S_1 b}$$

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$$B^2 = (1 + 4.36h/A).$$

P = Applied lateral force, in pounds.

S_1 = Permitted lateral-soil-bearing pressure as set forth in Table 9.11, based on a depth one-third the depth of embedment.

S_3 = Permitted lateral-soil-bearing pressure as set forth in Table 9.11, based on a depth equal to the depth of embedment.

b = Diameter, in feet, of round post or footing or diagonal dimension of square post or footing.

h = Distance, in feet, from ground surface to point of application of P .

d = Depth of embedment in earth, in feet, but not more than 12 feet for computing lateral pressure.

907.4 Design formula—constrained. The following formula may be used to determine the depth of embedment required to resist lateral loads where constraint is provided at the ground surface, such as a rigid floor or pavement.

$$(d)^2 = 4.25 \frac{Ph}{S_3 b}$$

907.5 Concrete slabs on grade.

- Where concrete slabs are placed directly on the supporting soil, the subgrade shall first have been prepared by removing all organic matter and debris and the subgrade and fill shall be thoroughly compacted by approved mechanical methods. All fill placed under slabs shall be clean soil, free of debris and other deleterious materials and shall be placed in accordance with the requirements of Subsection 905.4.
- Where the floor covering to be placed on the slab is sensitive to moisture, a membrane or other approved method shall be used to control moisture infiltration.
- Concrete floor slabs placed directly on the supporting soil shall be a minimum of 3½ inches thick.

SECTION 908 PILE FOUNDATIONS

908.1 Conditions of use.

- The use of types of piles not specifically mentioned in this Subsection and the use of piles under conditions not specifically covered herein shall be permitted, subject to approval of the Building Official, upon submission of acceptable test data, calculations or other information relating to the properties and load-carrying capacity of such piles.
- All piles standing unbraced in air, water or other material not capable of lateral support, shall conform with the applicable column formula as specified in this Code. Such piles placed in firm ground may be considered fixed and laterally supported at 5 feet below the ground surface and when placed in soft material, at 10 feet below the ground surface, unless otherwise

required by the Building Official after a foundation investigation by an approved agency.

- Where cast-in-place piles are used, reinforcement shall extend 10 feet below the plane where the soil provides lateral support. Sufficient reinforcing for all types of piles shall be provided at the junction of the pile and pile cap or grade beam to make a suitable connection. Shells conforming to the requirements of Subsection 908.8(a)6 may be considered as reinforcement.
- Consideration shall be given to reduction of the permitted pile load when piles are placed in groups. Where soil conditions make such load reductions advisable or necessary, the axial load permitted for a single pile shall be reduced by any method approved by the Building Official.
- Reinforced concrete caps shall be provided for all pile clusters and such caps shall extend laterally not less than 6 inches beyond the extreme pile surface and vertically not less than 4 inches below the pile butt. Pile caps may be omitted when the piles are used to support grade beams, provided that the parts of the grade beams acting in place of the pile cap shall carry the loads as computed by a recognized method of analysis.
- Individual pile or caisson footings shall be interconnected by ties, each of which can carry a horizontal force equal to 5 percent of the larger pile cap loading in tension and compression, unless it can be demonstrated that equivalent restraint can be provided by other approved methods.

908.2 Permitted pile methods.

- Method of determining.** Axial and lateral loads on piles shall be determined by an approved formula, by load tests or by a foundation investigation by an approved agency. A foundation investigation shall be made if required by the Building Official.
- Tests.**

- Dynamic load tests.** The axial load on a pile shall not exceed the value given by the following formulas, unless such load is determined as specified in Paragraph (a) or in Subsection 908.1(a).

Allowable axial load = $R/4$ for all piles.

Where:

$$R \text{ (for steel piles)} = \frac{12Wh \frac{W + 0.25P}{W + P}}{S + \frac{RL \ 24,000}{AE}}$$
$$R \text{ (for other piles)} = \frac{12Wh \frac{W + 0.1P}{W + P}}{S + \frac{RL \ 24,000}{AE}}$$

Where:

R = Ultimate driving resistance, in tons.

W = Weight of striking parts, in tons.

H	=	Height of striking parts, in feet.
Wh	=	Striking energy, in foot-tons.
P	=	Weight of pile, in tons.
S	=	Permanent settlement of pile under the average of the last 10 blows, in inches.
L	=	Length of pile, in feet.
A	=	Average right cross-sectional area of pile material, in square inches.
E	=	Modulus of elasticity of pile, in pounds per square inch.

2. **Static load test.** Single piles when tested shall be loaded to at least twice the design load, and should pile groups be tested, the test load shall be not less than $1\frac{1}{2}$ times the total design load for the group. All load tests on piles shall be conducted in compliance with procedures set forth in EPCOT Standard 9-3, unless modified with the concurrence of the Building Official.

908.3 Driven piles.

- (a) **Penetration.** Piles supporting buildings or structures shall be driven to a resistance and penetration in accordance with the plans and specifications.
- (b) **Jetting.** Piles may be jetted only when authorized by the Building Official and under supervision of a Professional Engineer registered in the State of Florida. No jetting shall be permitted that may be detrimental to existing structures or piles previously driven.

908.4 Wood piles. Stresses permitted in compression parallel to the grain of wood piles shall comply with the requirements of Section 1010 (see Section 201 of EPCOT Standard 9-4). Wood piles shall comply with the following requirements:

- (a) Wood piles shall be of one piece and shall conform to EPCOT Standard 9-5.
- (b) Untreated piles may be used only when it has been established that the cutoff will be below the lowest ground water level assumed to exist during the life of the structure.
- (c) Pressure preservative treatment for piles as set forth herein shall be in conformance to the requirements of EPCOT Standard 1010-20 for the treatment of wood piles. Preservative treatment required herein may be omitted for rot-and-borer-resistive piles when satisfactory evidence of these characteristics is presented to the Building Official.
- (d) Wood piles supporting structures over the ground may be cut off at any elevation below the ground surface when such piles have been treated with the equivalent of Grade 1 creosote oil under pressure so as to retain not less than 12 pounds of creosote oil per cubic foot. In such cases, the pile butt shall be coated with two applications of hot creosote oil.
- (e) The top of wood piles supporting a structure over water may project above the water to such height as may be necessary, when piles used to support structures have

been treated with the equivalent of Grade 1 creosote oil or 70-30 creosote-coat tar solution under pressure so as to retain not less than 20 pounds of creosote oil or creosote-oil tar solution per cubic foot or to refusal.

- (f) Wood piles shall be driven with a protective driving cap or ring when necessary to prevent brooming or splitting of the butt. When brooming or splitting occurs, such piles shall be cut back to solid wood before the final resistance to penetration is measured.
- (g) If required, when driving through or to hard material or to rock, wood piles shall be fitted with metal protective shoe approved by the Building Official.

908.5 Precast concrete piles. Precast concrete piles shall have a compressive stress in the concrete not to exceed $0.225f'_c$ and the stress in the reinforcing steel shall not exceed the values specified in EPCOT Standard 1003-1. Precast concrete piles shall conform to the following requirements:

- (a) The piles shall be cast of concrete having an ultimate compressive strength of not less than 3,000 psi and shall be reinforced with a minimum of four longitudinal steel bars having an area of not less than 1 percent, nor more than 4 percent of the gross concrete area.
- (b) All longitudinal bars shall be of uniform size and shall be tied by not less than No. 2 hoops spaced 8 inches in the body of the pile and not over 3 inches for the first 18 inches from both the butt and the tip.
- (c) All reinforcement shall be protected by 2 inches or more of concrete, except that for piles subjected to the action of open water, waves or other severe exposure, a 3-inch protective covering shall be placed in the zone of such exposure.
- (d) For point-bearing piles, the concrete area of the tip shall be not less than 75 percent of the area of the butt.
- (e) All precast concrete piles shall have their date of manufacture and the lifting points clearly marked on the pile.
- (f) Concrete piles shall not be driven until they have attained their full specification strength as verified by tests, nor shall the piles be removed from the forms until 50 percent of the specification strength has been attained. Piles shall not be transported and not driven until they have been cured for not less than 7 days for Type I cement and 3 days for Type III cement.

908.6 Prestressed precast concrete piles. Prestressed precast concrete piles shall conform to Subsection 908.5 and to Section 1003 (see EPCOT Standard 1003-1, Chapter 26 as amended by EPCOT Standard 1003-2), except as follows:

- (a) Prestressed concrete piles shall be cast of concrete having a compressive strength of not less than 5,000 psi at the time of driving and 3,000 psi before transfer of the prestressing force. The prestressing element shall not be stressed initially in excess of 75 percent of its ultimate strength. Elements shall transfer a compressive stress to the concrete, after losses, of not less than 0.08 of the specified strength at driving. Under loads other than handling, no tension will be permitted in the concrete.

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- (b) Longitudinal reinforcing shall be protected by 2 inches of concrete and shall be tied by No. 2 hoops or No. 5 AS & W gage spirals spaced at 8 inches in the body of piling 14 inches or smaller, 9 inches in the body of piling 16 inches or larger, and not more than 3 inches for the first 18 inches from both the butt and the tip.

908.7 Structural steel shapes. The materials used for structural steel piles shall conform to the requirements of Section 1009 (see EPCOT Standard 1009-5). Sections used may be rolled sections of comparable fully welded built-up sections from plate. No section shall have an average thickness of metal less than $\frac{3}{8}$ inch. The permitted working stress shall not exceed 50 percent of the minimum specified yield stress of the material.

908.8 Cast-in-place concrete piles.

- (a) Metal-cased concrete piles shall consist of a steel shell driven in intimate contact with the surrounding soil and filled with concrete, and shall conform to the requirements of Section 1003 and the following provisions:
1. Steel shells may be uniformly tapered, step tapered, cylindrical or a combination of such shapes and may be laterally corrugated, spirally corrugated, longitudinally fluted or plain.
 2. Pile shells and end closures shall be of sufficient strength and rigidity to permit their being in accordance with the driving method used and to prevent harmful distortion caused by soil pressures or by driving of adjacent piles until filled with concrete. A reduction of cross-sectional area in excess of 15 percent shall be cause for rejection. The shells also shall be sufficiently water tight to exclude water during the placing of concrete. All rejected piles shall be removed or filled with gravel or concrete.
 3. The minimum diameter of a pile shell shall be 8 inches.
 4. Concrete for cast-in-place piles shall develop a compressive strength of not less than 3,000 psi at 28 days. The concrete shall be deposited in a continuous operation to ensure a full-sized pile without voids or separation. Concrete shall be placed in the dry. The pile may be sealed by depositing concrete by tremie or other approved method.
 5. Splices of shell sections shall be designed to ensure the alignment of the shells and to develop the full strength of the shell section.
 6. The load on the shell shall not exceed 12,000 psi multiplied by the area of the shell. Shells having a wall thickness of 0.16 inch or more may be considered as carrying part of the load. The metal for the shells shall conform to the requirements of EPCOT Standards 9-6 and 1009-20.
 7. For friction piles, the allowable load shall be computed at the cross section located at a point two-thirds of the embedded length of the pile, in

material providing suitable lateral support, measured upward from the tip. The load on the concrete shall not exceed 25 percent of the 28-day strength of the concrete, multiplied by the concrete area.

8. For end-bearing piles the concrete area of the critical section shall be such that the unit stress on the concrete does not exceed $0.25f'_c$ under the pile load. The area of the shell and the critical section of the concrete shall be taken at the elevation where the pile enters the stratum furnishing end bearing.
- (b) Uncased concrete piles shall consist of concrete cast-in-place against earth in drilled holes with the following requirements:
1. Construction procedure shall be such as to ensure the exclusion of any foreign matter while securing a full-sized shaft.
 2. Concrete shall attain an ultimate compressive strength (f'_c) of 3,000 psi at 28 days.
 3. The compressive stress in the concrete shall not exceed $0.25f'_c$.

SECTION 909 FOUNDATION WALLS

909.1 General requirements. Foundation walls shall be designed and constructed in accordance with the requirements of Chapter 10 for the specific materials and with the following:

- (a) Where the nature of the soil is such that soil bearing of 1,000 psf or less is used for design, foundation walls or buildings shall be poured-in-place reinforced concrete or reinforced masonry from the footing to the bottom of the first- or ground-floor construction.
- (b) Where the nature of the soil is such that soil bearing more than 1,000 psf is used for design, foundation walls of buildings may be of unit masonry or concrete on continuous concrete footings.
- (c) The Building Official may approve isolated piers under the exterior walls of buildings in locations where extreme dampness exists.
- (d) Isolated piers may be substituted for interior foundation walls for wood frame buildings not more than one story, where the piers are not more than 24 inches high, are a minimum of 12 inches by 12 inches in cross-sectional dimension, and are located at points of concentrated loads not more than 8 feet apart.

SECTION 910 WOOD FOUNDATION SYSTEMS

910.1 General. Wood foundation systems shall be designed and constructed in accordance with the requirements of EPCOT Standard 1010-36.

CHAPTER 10

REQUIREMENTS BASED ON QUALITY, DESIGN AND APPLICATION OF THE MATERIALS OF CONSTRUCTION

SECTION 1001 QUALITY AND DESIGN

1001.1 Criteria.

- (a) The use of the materials of construction in the fabrication and erection of buildings and structures, and their components, shall conform to the requirements of Chapter 9 for design; and to recognized principles of mechanics, to established engineering practice, to the recognized standards of industry referred to herein as listed in Appendix A. The requirements of Chapters 5 through 8 for use of materials for occupancies, fire protection, types of construction and means of egress also shall apply.
- (b) Where the requirements of the EPCOT Standards conflict with the requirements of this Code, the provisions of this Code shall apply.
- (c) Materials and assemblies that perform satisfactorily when tested in accordance with EPCOT Standard 6-1 shall be accepted by the Building Official for use where fire-resistive rating is required. Testing of the materials of construction, when required by the Building Official, shall be in accordance with the requirements of Subsection 311.4.
- (d) Specific materials not mentioned in Sections 1002 to 1010 are subject to the regulations of this Code and may be approved by the Building Official in accordance with the requirements of Section 311, where there is doubt as to the acceptability of a material, method or type of construction under the requirements of this Code or the EPCOT Standards.
- (e) Standards used in the design, and listed on the drawings and in the specifications, shall be specific and not general. References to the latest editions, are not acceptable.

SECTION 1002 ALUMINUM

1002.1 Criteria.

- (a) Quality and design of aluminum used in buildings and structures shall conform to the requirements of the basic standard of the aluminum industry, designated EPCOT Standard 1002-1. Where that standard conflicts with the requirements of this Subsection and Subsection 1002.3, the requirements of those Subsections shall apply. EPCOT Standards listed in Appendix A for Section 1002 also are adopted as part of this Code.
- (b) Use of aluminum alloys and tempers other than those covered by this Section shall be permitted for structural members, provided that standards of performance not lower than required in this Section are substantiated and as approved by the Building Official.

1002.2 Identification.

- (a) Certificates from the manufacturer of the aluminum alloy shall be presented to the Building Official, stating that each lot has been sampled, tested and inspected in accordance with, and has met the requirements of, the applicable EPCOT Standards listed in Appendix A. Aluminum structural elements in the fabricator's plant shall be identified, segregated or otherwise handled at all times so that the separate alloys and tempers are positively identified and, after completion of fabrication identification, shall be as part of or affixed to completed aluminum members and assemblies, or to boxed or bundled shipments of multiple units prior to shipment from the manufacturer's plant.
- (b) If the identity of an aluminum-alloy structural member cannot be established, the Building Official may order tests performed by an approved independent agency in accordance with the appropriate Standard listed in Appendix A for Section 1002.

1002.3 Dissimilar materials.

- (a) Where aluminum parts are in conflict with dissimilar metal other than stainless, aluminized or galvanized steel, the facing surfaces shall have an approved paint or insulated barrier.
- (b) Where aluminum parts are in contact with wood, fiberboard or other porous materials that absorb water and cause corrosion, aluminum surfaces shall be protected with an approved paint. Aluminum in contact with concrete or masonry should be similarly protected when moisture is present.
- (c) Aluminum embedded in concrete shall be protected with approved paint when corrosive components are added to the concrete or when extended extremely corrosive conditions exist.
- (d) Aluminum in contact with water that may carry trace quantities of a dissimilar metal or its corrosion product shall be protected by an approved paint.

SECTION 1003 CONCRETE CONSTRUCTION

1003.1 Criteria.

- (a) All structures of reinforced concrete, including prestressed concrete, shall be designed and constructed in accordance with the provisions of EPCOT Standard 1003-1.
- (b) Structural members of plain concrete shall be designed and constructed in accordance with the provisions EPCOT Standard 1003-2. Concrete that is either unreinforced or contains less reinforcement than the minimum amount specified for reinforced concrete shall be classified as plain concrete.

1003.2 Concrete quality.

- (a) Concrete control of drawings, inspection, materials, proportioning, testing, evaluation, acceptance, mixing and placing, forms and details shall be in accordance with EPCOT Standard 1003-1.
- (b) EPCOT Standard 1003-32 shall be used as a guide for good practice and workmanship.

1003.3 Minimum slab thickness. The minimum thickness of concrete floor slabs supported directly on the ground shall not be less than 3½ inches unless designed by an architect or engineer. An approved vapor barrier shall be installed underneath the slab.

1003.4 Minimum concrete strength.

- (a) The minimum specified compressive strength, f'_c , for concrete designed and constructed in accordance with this Chapter, shall be 2,500 pounds per square inch (psi).
- (b) Tables 10.1 and 10.2 shall be used when strength data from trial batches or field experience is not available.

1003.5 Anchorage to concrete-strength design. The strength design procedure of anchors installed in concrete, including headed bolts, headed studs, hooked bolts (J-bolts or L-bolts), expansion anchors and undercut anchors shall be in accordance with Chapter 17 of ACI 318. The strength design procedure of anchors not within the scope of Chapter 17 of ACI 318 shall be approved by the Building Official.

SECTION 1004 GYPSUM CONCRETE AND PRECAST GYPSUM

1004.1 Criteria.

- (a) Quality and design of materials used in gypsum concrete and precast gypsum shall conform to the requirements of EPCOT Standard 1004-1 and to the Standards listed in Appendix A for Section 1004.
- (b) The provisions of Chapter 9 and this Section shall govern the design and installation of cast-in-place gypsum concrete slabs reinforced with wire mesh and applied over permanent forms that may or may not be supported by purlins; and shall also govern the design and installation of precast gypsum units applied directly to roof or floor framing members.
- (c) Reinforced gypsum concrete shall be designed by methods admitting or rational analysis based on established principles of mechanics. The general assumptions and principles specified for reinforced concrete shall be the basis of design for reinforced gypsum, as they apply.

1004.2 Limitations of use.

- (a) Cast-in-place gypsum concrete used for occupancies producing unusually high humidities, or for ceilings of structures not completely enclosed, shall be constructed with the use of nonabsorptive formboard or surfacing. Precast gypsum shall not be used under these conditions, except as approved by the Building Official.

**TABLE 10.1
MAXIMUM PERMISSIBLE WATER-CEMENT RATIOS AND MINIMUM CEMENT CONTENTS FOR CONCRETE**

SPECIFIED COMPRESSIVE STRENGTH f'_c psi ^a	MAXIMUM PERMISSIBLE WATER-CEMENT RATIO				
	Non-air-entrained concrete			Air-entrained concrete	
	Minimum sacks cement per cu. yd. concrete	Absolute ratio by weight	U.S. gallon per 94-lb. bag of cement	Absolute ratio by weight	U.S. gallon per 94-lb bag of cement
2,500	5	0.65	7.3	0.54	6.1
3,000	5½	0.58	6.6	0.46	5.2
3,500	6	0.51	5.8	0.40	4.5
4,000	6½	0.44	5.0	0.35	4.0
4,500	7	0.38	4.3	0.30	3.4
5,000	7½	0.31	3.5	2 ^b	See Note b

a. 28-day strengths for cements meeting strength limits of ASTM C150, Type I, IA, II or IIA, and 7-day strengths for Types III and IIIA.

b. For strengths above 4,500 psi with air-entrained concrete, proportions should be selected by the methods of ACI 318-02/318-R05.

**TABLE 10.2
CONCRETE AIR CONTENT FOR VARIOUS SIZES OF CONCRETE AGGREGATE**

NOMINAL MAXIMUM SIZE COARSE AGGREGATE, IN.	TOTAL AIR CONTENT PERCENT BY VOLUME
¾	6 to 10
1½	5 to 9
¾	4 to 8
1	3.5 to 6.5
1½	3 to 6
2	2.5 to 5.5
3	1.5 to 4.5

- (b) Concentrated loads, such as water tanks, fan bases, cooling towers, flagpoles and signs, shall be transmitted directly to the walls or to the primary footing.

1004.3 Testing.

- (a) One test of each day's pour of cast-in-place gypsum concrete shall be made and the results thereof presented to the Building Official. Cylinders or cubes shall be cast at the site, with a minimum of two specimens constituting a test. Specimens shall be tested and reported in accordance with EPCOT Standard 1004-2. To conform to the requirements of this Code, the average of any five consecutive strength tests for one class of cast-in-place gypsum shall be equal to or greater than the specified and not more than 20 percent of the strength.
- (b) Full-sized panels of precast gypsum concrete, when tested in accordance with EPCOT Standard 1004-4, shall sustain a load equivalent to five times the total design superimposed vertical dead load plus live load.

1004.4 Identification. All material used in gypsum concrete shall be delivered to the job in the original packages bearing the manufacturer's label.

SECTION 1005 GLASS AND GLAZING

1005.1 Labeling. Each light shall bear the manufacturer's label designating the type and thickness of glass. When approved by the Building Official, labels may be omitted from other than tempered glass providing an affidavit is furnished by the glazing contractor certifying that each light is glazed in accordance with the approved plans and specifications.

Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched or ceramic fired on the glass and be visible when the unit is glazed. Tempered spandrel glass is exempted from permanent labeling. This type of glass shall be identified with a removable paper label by the manufacturer.

1005.2 Louvered windows or jalousies. Regular plate, sheet or patterned glass in jalousies and louvered windows shall be no thinner than nominal $\frac{7}{32}$ inch and no longer than 48 inches. When other glass types are used, design shall be submitted to the Building Official for approval. Exposed glass edges shall be smooth.

Wired glass with wire exposed on longitudinal edges shall not be used in jalousies or louvered windows.

1005.3 Human impact loads. Individual glazed areas in hazardous locations defined in Subsection 1005.4 shall pass the test requirements of EPCOT Standard 1005-1.

Exceptions:

- 1. In other than Group E occupancies, polished wire glass for use in fire doors, fire windows and view panels in 1-hour fire-resistive walls shall be permitted to comply with EPCOT Standard 1005-2.
- 2. Approved plastic materials used as glazing in hazardous locations shall comply with the weathering requirements of EPCOT Standard 1005-2.

- 3. Glass-block walls conforming to EPCOT Standard 1005-3.

1005.4 Hazardous locations. The following shall be considered specific hazardous locations for the purposes of glazing:

- (a) Glazing in ingress and egress doors except wired glass in required fire doors and jalousies;
- (b) Glazing in fixed and sliding panels of sliding-type doors (patio and mall type);
- (c) Glazing in storm doors;
- (d) Glazing in all unframed swinging doors;
- (e) Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, showers and bathtubs, and glazing in any portion of a building wall enclosing such areas where the bottom exposed edge of the glazing is less than 60 inches above a standing surface;
- (f) Glazing, operable or inoperable, adjacent to a door in all buildings and within a 24-inch arc of the door in a closed position and whose bottom edge is less than 60 inches above the floor or walking surface; and
- (g) Glazing in fixed panels having a glazed area in excess of 9 square feet with the lowest edge less than 24 inches above the finished floor level or walking surface within 36 inches of such glazing. In lieu of safety glazing, such glazed panels may be protected with a horizontal member not less than $1\frac{1}{2}$ inches in height when located between 34 and 38 inches above the walking surfaces. The horizontal member shall be capable of withstanding a horizontal load of 50 pounds per lineal foot without contacting the glazing and shall be installed on each side of the glazing that is accessible from a walking surface.

Exception: The following products, materials and uses are exempt from the hazardous locations identified in Paragraphs (a) through (g):

- 1. Openings in doors through which a 3-inch sphere is unable to pass;
- 2. Leaded glass panels where no individual piece of glass has an area greater than 30 square inches;
- 3. Glazing materials used as curved glass panels in revolving doors;
- 4. Commercial refrigerated cabinet glazed doors; and
- 5. Faceted and decorative glass.

1005.5 Glass supports.

- (a) Glass supports, such as sash members, glazing stops or glazing clips, shall be considered firm when deflection of the support at design load does not exceed $\frac{1}{175}$ of the span.
- (b) Where other than firm support on all sides is provided, detailed shop drawings, specifications, and rational analysis and/or test data assuring data performance for the specific installation shall be prepared by engineers experienced in this work and shall be submitted for and receive, if warranted, formal approval by the Building Official.

1005.6 Wind loads.

- (a) Glass in windows, curtain and window walls, skylights, doors and other exterior applications shall be chosen to resist the wind loads in Section 904.
- (b) Maximum sizes of single regular (annealed) glass may be determined directly from Table 10.4. Maximum sizes of other glass types may be determined by first dividing the wind load determined in Section 904 by the factors in Table 10.3.
- (c) Table 10.4 is applicable for rectangular glass firmly supported on all four edges.
- (d) When approved by the Building Official, alternative means for selecting glass may be used in place of Tables 10.3 and 10.4.

1005.7 Glazing replacement. The installation or replacement of glass shall be as required for new installations.

TABLE 10.3
RELATIVE RESISTANCE TO WIND LOAD
(Assuming equal thickness)

GLASS TYPE	FACTOR ^a
Laminated ^b	0.75
Wired	0.50
Heat strengthened	2.00
Fully tempered	4.00
Insulating glass ^c -2 panes	1.70
-3 panes	2.55
Patterned ^d	1.00
Sandblasted ^e	0.40
Regular (annealed)	1.00

- a. Wind pressure determined from Section 904 should be divided by this factor for use with Table 10.4.
- b. Applies when two plies are identical in thickness and type; use total glass thickness, not thickness of one ply.
- c. Applies when each glass pane is the same thickness and type; use thickness of one pane.
- d. Use minimum glass thickness, i.e., measured at the thinnest part of the pattern; interpolation of Table 10.4 may be required.
- e. Factor varies depending upon depth and severity of sand blasting; value shown is minimum.

1005.8 Glass in handrails and guards.

- (a) **Materials.** Glass used as a handrail assembly or a guard section shall be constructed of either single fully tempered glass, laminated fully tempered glass or laminated heat strengthened glass. Glazing in railing in-fill panels shall be of an approved safety glazing material that conforms to the provisions of Subsection 1005.3. For all glazing types, the minimum nominal thickness shall be $\frac{1}{4}$ inch. Fully tempered glass and laminated glass shall comply with Category II of CPSC 16 CFR Part 1201 or Class A of ANSI Z97.1, listed in Chapter 35.
- (b) **Loads.** The panels and their support system shall be designed to withstand the loads specified in Subsection 902.2(h). A safety factor of four shall be used.
- (c) **Support.** Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be otherwise supported to remain in place should one

baluster panel fail. Glass balusters shall not be installed without an attached handrail or guard.

Exception: A top rail shall not be required where the glass balusters are laminated glass with two or more glass plies of equal thickness and the same glass type when approved by the Building Official. The panels shall be designed to withstand the loads specified in Section 902.

- (d) **Parking garages.** Glazing materials shall not be installed in handrails or guards in parking garages except for pedestrian areas not exposed to impact from vehicles.
- (e) **Glass supporting top rail.** When the top rail is supported by glass, the assembly shall be tested according to the impact requirements of ASTM E1996 and ASTM E1886. The top rail shall remain in place after impact.

1005.9 Glazing in athletic facilities. Reserved.

1005.10 Glazing in elevator hoistways and elevator cars.

- (a) **Glass in elevator hoistway enclosures.** Glass in elevator hoistway enclosures and hoistway doors shall be laminated glass conforming to ANSI Z97.1 or CPSC 16 CFR Part 1201.
- (b) **Fire-resistance-rated hoistways.** Glass installed in hoistways and hoistway doors where the hoistway is required to have a fire-resistance rating shall also comply with Section 703.
- (c) **Glass hoistway doors.** The glass in glass hoistway doors shall be not less than 60 percent of the total visible door panel surface area as seen from the landing side.
- (d) **Glass vision panels.** Glass in vision panels in elevator hoistway doors shall be permitted to be any transparent glazing material not less than $\frac{1}{4}$ inches in thickness conforming to Class A in accordance with ANSI Z97.1 or Category II in accordance with CPSC 16 CFR Part 1201. The area of any single vision panel shall not be less than 24 square inches and the total area of one or more vision panels in any hoistway door shall be not more than 85 square inches.
- (e) **Glass in elevator cars.** Glass in elevator car enclosures, glass elevator car doors and glass used for lining walls and ceilings of elevator cars shall be laminated glass conforming to Class A in accordance with ANSI Z97.1 or Category II in accordance with CPSC 16 CFR Part 1201.

Exception: Tempered glass shall be permitted to be used for lining walls and ceilings of elevator cars provided:

1. The glass is bonded to a nonpolymeric coating, sheeting or film backing having a physical integrity to hold the fragments when the glass breaks.
2. The glass is not subjected to further treatment such as sandblasting, etching,

heat treatment or painting that could alter the original properties of the glass.

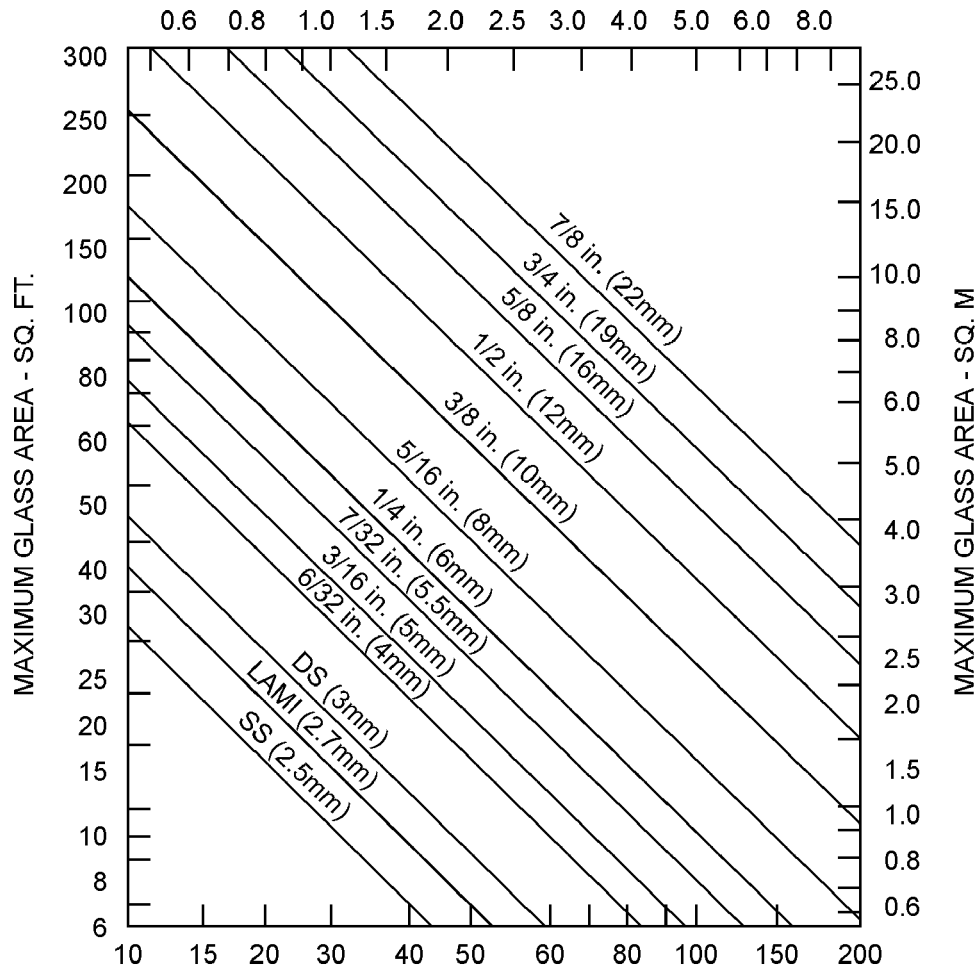
3. The glass is tested to the acceptance criteria for laminated glass as specified for Class A in accordance with ANSI Z97.1 or Category II in accordance with CPSC 16 CFR Part 1201.
- (f) **Surface area.** The glass in glass elevator car doors shall be not less than 60 percent of the total visible door panel surface area as seen from the car side of the doors.

SECTION 1006 MASONRY

1006.1 Criteria.

- (a) Quality and design of masonry construction shall comply with the requirements of this Section, Chapter 9 and the following EPCOT Standards:
 1. For brick masonry using solid clay and/or shale, use EPCOT Standards 1006-1 and 1006-2.
 2. For concrete masonry, use EPCOT Standard 1006-1 or 1006-7.

**TABLE 10.4
WIND LOAD CHART
DESIGN WIND LOAD—kPa**



LOADING = psf
 DESIGN WIND LOAD FROM SECTION 904 - LB. psf
 Design factor: 2.5
 Chart applies for Width-to-Length Ratios from 1:5 to 1:1
 Based on Minimum Glass Thickness Allowed in Fed. Spec. DD-G-451D

3. For glass masonry, use EPCOT Standard 1005-3 and Chapter 7 of ACI 530/ASCE 5/TMS 402.
 4. For other masonry, use EPCOT Standards 1006-1 and 1006-2.
 5. The standards listed in Appendix A for Section 1006 also are adopted as part of this Code.
- (b) Materials used in masonry construction shall comply with the requirements of EPCOT Standards 1006-1, 1006-2, 1006-28, 1006-29 and with the appropriate standards listed in Appendix A for Section 1006, and with the following requirements:
1. Water shall be clean and potable.
 2. Integral waterproofing compounds, accelerators or other admixtures shall not be used, except as approved by the Building Official.
 3. Pure mineral mortar colors shall be used and the quantity and quality shall be approved by the Building Official.
 4. Antifreeze compounds shall not be used to lower the freezing point of mortar.
 5. Secondhand materials shall not be used unless such materials have been cleaned and conform to the requirements of the appropriate standard listed in Appendix A for Section 1006.
- (c) Where no standard or tentative specification is available, the following criteria shall be applied:
1. **Glazed building units.** Building brick or concrete masonry units with glazed faces shall conform to the requirements of specifications listed in Appendix A for brick or concrete masonry units.
 2. **Natural stone.** Stone used in masonry shall be sound, free from friable inclusions, and shall have strength, durability and resistance to impact and abrasion for the intended use. The Building Official may require evidence as necessary to establish suitability of natural stone for conditions of use.

1006.2 Testing. Testing and grading of masonry materials shall comply with the applicable ASTM testing standards listed in Appendix A, with EPCOT Standard 1006-2, Table 1006-2.1, and with EPCOT Standards 1006-1, 1006-28 and 1006-29, as appropriate.

1006.3 Precautions during erection.

- (a) Masonry walls in locations where they may be exposed to high winds during erection shall be braced to withstand the horizontal pressure. Backfill shall not be placed against walls until the walls have been braced.
- (b) Brick made of clay or shale shall be wet when laid unless the gain in weight resulting from partial immersion flatwise in $\frac{1}{8}$ inch of water for 1 minute is less than $\frac{3}{4}$ ounce per 30 square inches of immersed area. Brick shall be prewetted when the initial rate of absorption is

greater than 30 grams per 30 square inches per minute or 0.035 ounce per square inch per minute.

- (c) Structural clay tile having absorption of 12 percent or more shall be wetted before laying.
- (d) Masonry units may be re-used when clean and whole, and when they conform to the requirements of EPCOT Standard 1006-2, except that working stresses shall be 50 percent of those permitted for new material. Salvaged masonry units, which are to be re-used, shall be approved as to the quality, conditions and compliance with the requirements for new masonry units. The units shall be of whole, sound material, free from cracks and other defects that would interfere with their proper laying or use and shall be cleaned free of old mortar before re-use. Masonry units to be re-used as structural units in areas subject to the action of the weather or soil shall not be permitted unless representative samples are tested for compliance with the applicable requirements.
- (e) Masonry shall be protected against freezing for at least 48 hours after being laid. Unless adequate precautions against freezing are taken, masonry units shall not be laid when the temperature is below 32°F on a rising temperature or below 40°F on a falling temperature at the point where the work is in progress, in accordance with EPCOT Standards 1006-1, 1006-23 and 1006-30.

SECTION 1007 PLASTERING, LATHING AND INSTALLATION OF WALLBOARD

1007.1 Criteria.

- (a) The installation of plaster and lath shall be as specified in EPCOT Standard 1007-1. Wallboard shall meet the specifications of EPCOT Standard 1007-3, and shall be installed and finished as required in EPCOT Standard 1007-4. When required to be fire resistive, lathing, plastering and wallboard shall meet the requirements of EPCOT Standard 6-1 and Chapter 7.
- (b) Lathing, plastering and wallboard materials, and methods of installation, shall conform to the requirements of the applicable EPCOT Standard as listed in Appendix A for Section 1007. The Building Official may require tests to be made to determine compliance with the provisions of this Section and the EPCOT Standard listed when the permit holder has been notified at least 24 hours in advance of the time set for making tests.
- (c) Pneumatically placed Portland cement plaster shall conform to the requirements of EPCOT Standard 1007-2.

1007.2 Inspection. No lath or gypsum wallboard, or their attachments, shall be covered or finished until inspected and approved by the Building Official in accordance with Section 306.

1007.3 Identification. All materials used in the installation of lathing, plastering and wallboard shall be delivered to the job in the original packages bearing the manufacturer's label.

SECTION 1008 PLASTICS

1008.1 Criteria. Plastic materials may be any approved plastic as defined in this Section that complies with the requirements of the EPCOT Standards listed in Appendix A for Section 1008. The Building Official shall require that sufficient technical data be submitted to substantiate the proposed use of a plastic and, when it is determined that the evidence qualified the material for the proposed use, the Building Official may approve the use of the plastic, subject to the requirements of this Section.

1008.2 Identification. Each sheet, roll or piece of plastic for use in building construction or alteration for which a permit is required shall be identified with a mark or decal showing the intended use, acceptable to the Building Official.

1008.3 Definitions. For the purpose of this Code, certain terms are defined and explained as follows:

- (a) **Approved plastics.** Plastics that have a burning rate no more than $2\frac{1}{2}$ inches per minute when tested in nominal 0.060-inch thickness in accordance with EPCOT Standard 1008-2 or that have a flame spread rating of not more than 200 when tested in accordance with EPCOT Standard 6-3 in the manner intended for use. The smoke density rating shall not be more than 450 when tested in accordance with EPCOT Standard 6-3 in the manner intended for use or a smoke density rating not more than 75 when tested in accordance with EPCOT Standard 1008-3 in the thickness intended for use. Products of combustion shall be not more toxic than products of combustion from untreated wood under similar conditions of test.
- (b) **Plastic exterior wall panels.** Plastic panels that are fastened directly to structural members, structural panels or sheathing that are used for light transmission in exterior walls.
- (c) **Plastic glazing materials.** Light-transmitting materials that are set in a frame or sash and not held by mechanical fasteners that pass through the glazing material.

1008.4 Design.

- (a) Plastics used in buildings or structures shall be approved plastics as defined in this Section and shall comply with the following requirements:
 - 1. For interior finish and trim, see Section 711.
 - 2. As exterior veneer, see Section 710 and EPCOT Standard 7-8.
 - 3. For skylights, see Section 706.
 - 4. For light-transmitting assemblies, see Subsection 706.4.
 - 5. For awnings and canopies, see Subsection 402.6.
- (b) Plastic materials shall be of adequate strength and durability to withstand design loads as specified in Chapter 9. Technical data shall be submitted to the Building Official by an approved laboratory or testing agency to establish stresses, maximum unsupported spans and

other information required by the Building Official for the various thicknesses and forms of plastics used.

- (c) Fastenings shall withstand design loads as specified in Chapter 9. Allowance shall be made for expansion and contraction of plastic material in accordance with the coefficient of expansion of the plastic and the materials used with it.

SECTION 1009 STEEL

1009.1 Criteria.

- (a) The quality, design, fabrication, erection and delivery of steel used in buildings and structures shall conform to the provisions, specifications and standards of Section 1009 and Appendix A for Section 1009.
- (b) None of the material standards referred to in this Section or in Appendix A shall exclude the use of material ordered or produced, or other than listed specifications, under the following conditions:
 - 1. The material shall conform to the chemical and mechanical requirements of one of the listed specifications or other published specifications that establishes the properties and suitability of the material for the intended use.
 - 2. The material shall be subject to analysis, tests and other controls as required by the Building Official in accordance with the appropriate listed specification and as provided in Section 311.

1009.2 Identification.

- (a) All steel for structural load-bearing use shall be identified for conformity to the order grade as specified in the appropriate EPCOT Standard listed in Appendix A.
- (b) The fabricator or supplier shall maintain the identity of the material from the point of manufacture to the point of installation, and he shall maintain procedures and records attesting to the fact that the specified grade has been supplied in conformance to the applicable EPCOT Standard listed in Appendix A for Section 1009.

1009.3 Testing. Where steel is not readily identifiable as to grade from marking and test records, tests shall be made to determine conformity to the appropriate EPCOT Standard. The fabricator or supplier shall furnish an affidavit of compliance with the Standard when requested to do so by the Building Official.

SECTION 1010 WOOD

1010.1 Criteria.

- (a) The quality and design of solid sawn wood members, structural glued-laminated wood members and plywood or nonveneer structural panel assemblies and their fastenings shall conform to the requirements of this Section and to the basic standards of the industry listed in EPCOT Standards 1010-1 through 1010-36. Other Standards listed in Appendix A for Section 1010

also are adopted as part of this Code. For heavy timber standards, see Section 1010-9.801.

- (b) Classification and grading of all species of lumber shall conform to the requirements of Section 1010-1 for the individual species.

1010.2 Limitations of use.

- (a) Wood members shall not be used to support the dead load of masonry or concrete except that nonstructural masonry or concrete floor surfacing not more than 4 inches thick may be supported by wood members and structures may rest on wood piles constructed in accordance with the requirements of Subsection 908.4 and pressure treated in accordance with the requirements of EPCOT Standard 9-5.
- (b) Wood members shall not be used to resist horizontal forces in buildings over one story when constructed with masonry or concrete, except that wood floor and roof members may be used in horizontal trusses and diaphragms to resist horizontal forces imposed by wind. Wood members shall not be used to transmit lateral forces by rotation of the truss or diaphragm in masonry or concrete buildings. Lateral earth pressures shall not be resisted by wood members in buildings.
- (c) The Building Official may deny permission for use of wood members where permissible grade characteristics or defects are present in a combination that will affect the strength of the member for the use intended.

1010.3 Identification.

- (a) Where structures are designed for use of stress grade lumber or where structural glued laminated or plywood is used structurally, the maximum unit stresses for the species and grade shall be shown on the plans filed with the Building Official.
- (b) Structural glued-laminated timber shall be manufactured and identified as required in ANSI/AITC A190.1. (See EPCOT Standard 1010-18.)
- (c) All stress grade lumber shall be identified by grade mark or certificate of inspection issued by an approved agency as conforming to the requirements of EPCOT Standards 1010-11 through 1010-17 for the species used.
- (d) Plywood and other structural-use panels used structurally, including siding, roof sheathing and wall sheathing, subflooring, diaphragms and build-up members, shall be identified and grade marked by an approved agency indicating compliance with the requirements of EPCOT Standards 1010-19 and 1010-32, respectively.
- (e) All lumber, sawn timber, plywood and poles supporting permanent structures are required to be pressure treated as described in the standards listed in Appendix A and shall bear a product identification mark. Quality control inspection agencies for pressure-treated wood shall be certified as to competency of performance by an approved accrediting organization.

All pressure-treated lumber 6 inches or less in thickness and all pressure-treated plywood shall be marked with an indelible ink stamp at the treating facility. The

stamp shall contain, as a minimum, the following information:

1. The treating company and plant location;
2. The American Wood Preservers' Association (AWPA) standards to which the product is treated;
3. The quality mark of an approved inspection agency, which maintains continued supervision, testing and inspection over the quality of the product as described in AWPA standards;
4. The preservative used;
5. The year of the treatment;
6. The amount of retention of the chemical per cubic foot of wood;
7. The quality standard of the inspection agency;
8. Dry or kiln dried after treatment, if applicable; and
9. The purpose for which the wood has been treated (ground contact, above ground or foundation).

Exception: When the pressure-treated material will be used where all four sides are in full view and will not be covered by paint or other opaque finish, a certificate of treatment may be accepted in lieu of a permanent ink stamp. The certificate shall contain the same information as the stamp.

Pressure-treated wood more than 6 inches in width and more than 6 inches thick shall be marked with an indelible ink stamp or tagged at the treating facility.

- (f) Lumber and plywood required to be fire retardant shall be identified by the seal of an approved independent inspection agency, certifying compliance with AWPA C20 and C27. (See EPCOT Standard 1010-21.)
- (g) Wood-based fiberboard and particle board shall be identified by the manufacturer as meeting the appropriate EPCOT Standard as listed in Appendix A.

SECTION 1011 THERMAL INSULATING MATERIAL

1011.1 General. Insulating materials, including vapor barriers, breather papers and similar coverings, shall comply with the requirements of this Section. Where a flame spread rating or a smoke-developed rating is specified in this Section, such rating shall be determined in accordance with ASTM E84. Any material that is subject to an increase in flame spread rating or smoke-developed rating beyond the limits herein established through the effects of age, moisture, or other atmospheric conditions, shall not be permitted.

1011.2 Concealed installation.

- (a) Insulating materials, when concealed as installed, in buildings of any type of construction, shall have a flame spread rating of not more than 75 and a smoke-developed rating of not more than 450.
- (b) When such materials are installed in concealed spaces in buildings of Type III, V or VI construction, the

flame spread and smoke-developed limitations do not apply to facings, provided that the facing is installed in contact with the unexposed surface of the ceiling, wall or floor finish.

1011.3 Exposed installation. Insulating materials when exposed as installed in buildings of any type of construction shall have a flame spread rating of not more than 25 and a smoke-developed rating of not more than 450.

1011.4 Roof insulation. The use of combustible roof insulation shall be permitted in any type of construction provided it is covered with approved roof coverings directly applied thereto.

1011.5 Loose-fill insulation. Loose-fill insulation materials, which cannot be mounted in the ASTM E84 apparatus without a screen or artificial supports, shall comply with the flame spread and smoke-developed limits of Subsections 1011.2 and 1011.3 when tested in accordance with CAN-4-S102.2-M83.

APPENDIX A

ADOPTION OF THE APPENDICES AND REFERENCED STANDARDS OF THE EPCOT BUILDING CODE

SECTION A-101 ADMINISTRATION

A-101.1 Scope. The appendices and Standards identified herein shall be enforced in accordance with the provisions of this Code.

A-101.2 Criteria. The Standards listed herein are sponsored by nationally recognized technical and engineering organizations. Where no national standard is available, the EPCOT compilation as listed shall apply. Where the provisions of this Code and the EPCOT Standards are in conflict, the requirements of this Code shall apply.

SECTION A-201 APPENDICES

A-201.1 Legality. The appendices identified in this Subsection are legally a part of this Code and their provisions shall be enforced by the Building Official.

Appendix A	Adoption of the Appendices and Referenced Standards of the EPCOT Building Code
Appendix B	Fire Limits
Appendix C	Calculated Fire Resistance
Appendix D	Regulation of Signs and Outdoor Advertising Structures
Appendix E	Regulation of Private Swimming Pools
Appendix F	Regulation of Building Construction and Demolition Operations
Appendix G	Regulations for Construction of Stages, Enclosed Platforms, Motion Picture Projection Rooms and Open-Air Event or Performance Platforms
Appendix H	Regulation of Commercial Stables
Appendix I	Regulation of Covered Walkways and Malls
Appendix J	Group S-4 Occupancies and Manufactured Buildings
Appendix K	Tentative Requirements Pertaining to Heat Radiation Between Buildings
Appendix L	Tentative Design Criteria for Fire Protection of Exterior Structural Elements
Appendix M	Regulations for Construction of Motion Picture and Television Soundstages
Appendix N	Regulations for Membrane Structures and Tents
Appendix O	Reserved

Appendix P	Regulations Covering Building Dead Loads
Appendix Q	Regulation of Animal Support Facilities
Appendix R	Swimming Pools and Bathing Places

SECTION A-301 EPCOT REFERENCED STANDARDS

A-301.1 Legality. The Standards listed herein are legally part of this Code and their requirements shall be enforced by the Building Official.

EPCOT Standard Number	Title of Standard	Author Designation and Year of Publication
Chapter 5—Requirements Based On Occupancy		
5-1	Elevators, Dumbwaiters, Escalators, Moving Walks, Manlifts and Transporting Assemblies	EPCOT Compilation
5-2	Health Care Facilities Code	NFPA 99—2015
5-3	<i>EPCOT Accessibility Code for Building Construction</i>	2018 Edition
5-4	Flammable and Combustible Liquids Code	NFPA 30—2015
5-5	Liquefied Petroleum Gas Code	NFPA 58—2014
5-6	Dry Cleaning Plants	NFPA 32—2011
5-7	Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Particulate Solids	NFPA 91—2004
5-8	Grandstands, Folding and Telescopic Seating, Tents and Membrane Structures	NFPA 102—2016
5-9	Heliports	NFPA 418—2011
5-10	Acoustics—Laboratory Measurement of Sound Insulation of Building Elements	ISO 10140-5—2010
5-11	Spray Application Using Flammable or Combustible Materials	NFPA 33—2018
5-12	Safety Standard for Amusement Attractions and Amusements Buildings	EPCOT Compilation
5-13	Amusement Ride and Devices	EPCOT Compilation

5-14	Incinerators and Waste and Linen Handling Systems and Equipment	NFPA 82—2014	(b)Sprinkler Systems in Low-Rise Residential Occupancies	NFPA 13R—2013
5-15	Reconstitution of Irradiated Charpy-Sized Specimens	ASTM E1253—2013	(c)Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	NFPA 13D—2013
5-16	Fire Test of Foamed Plastics Used for Decorative Purposes	UL 1975—2006		
5-17	Standard Method of Fire Tests for Flame-Propagation of Textiles and Films	NFPA 701—2010	7-11 (a)Low Expansion Foam	NFPA 11—2010
5-18	Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source	NFPA 253—2015	(b)Medium- and High-Expansion Foam Systems (Withdrawn)	NFPA 11A—1999
			7-12 Wetting Agents	NFPA 18—2017
			7-13 Dry Chemical Extinguishing Systems	NFPA 17—2013
			7-14 Standpipe and Hose Systems	NFPA 14—2013
			7-15 Portable Fire Extinguishers	NFPA 10—2013
			7-16 Halon 1301 Fire-Extinguishing Systems	NFPA 12A—2009
			7-17 Ventilation Control and Fire Protection of Commercial Cooking Operations	NFPA 96—2004
			7-18 Criteria for Acceptance of Foam Plastics	EPCOT Compilation
			7-19 National Fire Alarm and Signaling Code	NFPA 72—2013
			7-20 Installation, Maintenance and Use of Protective Signaling Devices	NFPA 72—2013
			7-21 Automatic Fire Detectors	NFPA 72—2013
			7-22 Installation, Maintenance and Use of Notification Appliances for Protective Signaling Systems	NFPA 72—2013
			7-23 Household Fire Warning Equipment	NFPA 72—2013
			7-24 Fire Tests of Through-Penetration Firestops	ASTM E814—2013
			7-25 Installation of Private Fire Service Mains and Their Appurtenances	NFPA 24—2019
			7-26 Inspection, Testing and Maintenance of Water-Based Fire Protection System	NFPA 25—2014
			7-27 National Electrical Code	NFPA 70—2014
			7-28 Air Leakage Tests of Door Assemblies—with Revisions through February 2015	UL 1784—2001
			7-29 Smoke Management Systems in Malls, Atria and Large Spaces	NFPA 92 B—2009
Chapter 6—Requirements Based on Types of Construction				
6-1	(a)Part 1—Fire Tests of Building Construction and Materials	ASTM E119—2012A		
	(b)Part 2—Fire-Resistive Time Periods for Building Components	EPCOT Compilation		
6-2	Behavior of Materials in a Vertical Tube Furnace at 750°C	ASTM E136—2012		
6-3	Surface-Burning Characteristics of Building Materials	ASTM E84—2013A		
6-4	Surface Burning Characteristics of Building Materials—with Revisions through September 2013	UL 723—2008		
Chapter 7—General Construction Requirements for Fire Safety				
7-1	Fire Dampers—with Revisions through May 2014	UL 555—2006		
7-2	Fire Tests of Door Assemblies (Withdrawn 1995)	ASTM E152—1981 E2		
7-3	Fire Test of Window Assemblies (Withdrawn 1995)	ASTM E163—1984 E1		
7-4	Smoke Detectors for Fire Alarm Systems	UL 268—2009		
7-5	Tin-Clad Fire Doors—with Revisions through December 2013	UL 10-A—2009		
7-6	Fire Doors and Other Opening Protectives	NFPA 80—2013		
7-7	Fire-Retardant Roof Coverings	EPCOT Compilation		
7-8	Application of Veneer	EPCOT Compilation		
7-9	Smoke and Heat Venting	NFPA 204—2012		
7-10	(a)Installation of Sprinkler Systems	NFPA 13—2013		

7-30	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing	ASTM D2898—2010	7-50	Luminous Egress Path Marking Systems—with Revisions through November 2010	UL 1994—2004
7-31	Seamless Copper Pipe, Standard Sizes	ASTM B42—2010	7-51	Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes	ASTM E1996—2005, 2006, 2009, 2012a or 2014a
7-32	Seamless Red Brass Pipe, Standard Sizes	ASTM B43—2009	7-52	Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials	ASTM E1886—2009 or 2005 or 2012 or 2013a
7-33	Seamless Copper Tube, Bright Annealed (Metric)	ASTM B68—2011	Chapter 9—Design Requirements		
7-34	Seamless Cooper Water Tube	ASTM B88—2009	9-1	Laboratory Compaction Characteristics of Soil Using Modified Effort	ASTM D1557—2012
7-35	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B251—2010	9-2	Density and Unit Weight of Soil in Place by the Sand-Cone Method	ASTM D1556—2007
7-36	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	ASTM B280—2008	9-3	Deep Foundations Under Static Axial Compressive Load	ASTM D1143/D1143M—2007e1
7-37	Cast Copper Alloy Solder Joint Pressure Fittings	ASME B16.18—2012	9-4	Establishing Allowable Stresses for Round Timber Piles	ASTM D2899—2012
7-38	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ASME B16.22—2001 (Reaffirmed 2010)	9-5	Round Timber Piles	ASTM D25—2012
7-39	Smoke Door Assemblies and Other Opening Protectives	NFPA 105—2013	9-6	Welded and Seamless Steel Pipe Piles	ASTM A252—2010)
7-40	Wet Chemical Extinguishing Systems	NFPA 17A—2013	9-7	Minimum Design Loads for Buildings and Other Structures	ASCE 7—2010
7-41	Stationary Pumps for Fire Protection	NFPA 20—2013	9-8	Guide Specifications for Design of Metal Flagpoles	ANSI/NAAMM FP 1001—1997
7-42	Carbon Monoxide (CO) Detection and Warning Equipment	NFPA 720—2015	9-9	Structural Standards for Steel Antenna Towers and Antenna Supporting Structures (Revised 2003)	ANSI/TIA-222F—1996
7-43	Standard Test Methods for Fire Tests of Building Construction and Materials	ASTM E119—2012a	9-10	Approval Standard for Class 1 Insulated Steel Deck Roofs	FM 4450—1989
7-44	Fire Tests of Building Construction and Materials	UL 263—2011	9-11	Approval Standard for Single-Ply Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction	FM 4470—2012
7-45	Fire Test for Window and Glass Block Assemblies	NFPA 257—2012	9-12	Tests for Uplift Resistance of Roof Assemblies—with Revisions through October 2013	UL 580—2006
7-46	Fire Tests of Window Assemblies	UL 9—2009			
7-47	Standard Classification for Abuse-resistant Nondecorated Interior Gypsum Panel Products and Fiber-reinforced Cement Panels	ASTM C1629/C1629M—2006(2011)			
7-48	Fire Safety and Emergency Symbols	NFPA 170—2015			
7-49	Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings	ASTM E2073—2010			

9-13 Uplift Tests for Roof Covering Systems—with Revisions through September 2015 UL 1897—2012

9-14 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference ASTM E1592—2005(2012)

Chapter 10*—Requirements Based on Quality, Design and Application of the Materials of Construction

*The listing of EPCOT Standards for Chapter 10, because of its length, is subdivided into sections for each material. Except when Test Method is indicated, the Standard is a specification.

Section 1002—Aluminum

1002-1 Aluminum Design Manual: Part 1-A Specification for Aluminum Structures ADM1—2015

1002-2 Aluminum and Aluminum-Alloy Sheet and Plate ASTM B209—2014

1002-3 Aluminum and Aluminum-Alloy Drawn Seamless Tubes ASTM B210—2012

1002-4 Aluminum and Aluminum-Alloy Rolled or Cold Finished Bars, Rods and Wire ASTM B211—2012el

1002-5 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes ASTM B221—2014

1002-6 Aluminum and Aluminum-Alloy Drawn Seamless Tubes for Surface Condensers, Evaporators and Heat Exchangers ASTM B234—2017

1002-7 Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube ASTM B241/B241M—2016

1002-8 Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled-Ring Forgings ASTM B247—2015

1002-9 Aluminum-Alloy 6061-T6 Standard Structural Profiles ASTM B308/B308M—2010

1002-10 Structural Welding Code—Aluminum AWS D1.2

1002-11 Aluminum and Aluminum Alloy Rivet and Cold-Heading Wire and Rods ASTM B316/B316M—2015

1002-12 Aluminum-Alloy Extruded Structural Pipe and Tube ASTM B429/B429M—2010el

Section 1003—Concrete Construction

1003-1 Building Code Requirements for Structural Concrete ACI 318—2014

1003-2 Reserved

1003-3 Portland Cement ASTM C150/C150M—2012

1003-4 Reserved

1003-5 Blended Hydraulic Cements ASTM C595—2013

1003-6 Concrete Aggregates ASTM C33/C33M—2013

1003-7 Lightweight Aggregates for Structural Concrete ASTM C330/C33M—2009

1003-8 Organic Impurities in Fine Aggregates for Concrete ASTM C40/C40M—2019

1003-9 Air-Entraining Admixtures for Concrete ASTM C260/C260M—2016

1003-10 Chemical Admixtures for Concrete ASTM C494/C494M—1999

1003-11 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete ASTM C618—2012a

1003-12 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement ASTM A615/A615M—2012

1003-13 Rail-Steel Deformed and Plain Bars for Concrete Reinforcement (Withdrawn) ASTM A616—1979

1003-14 Axle-Steel Deformed and Plain Bars for Concrete Reinforcement (Withdrawn) ASTM A617—1979

1003-15 Welded Deformed Steel Bar Mats for Concrete (Withdrawn) ASTM A184/A184M—2017

1003-16 Steel Wire, Plain, for Concrete Reinforcement (Withdrawn) ASTM A82—2002

1003-17 Steel-Welded Wire Reinforcement, Plain for Concrete ASTM A185—2002

1003-18 Steel Strand, Uncoated Seven-Wire for Prestressed Concrete ASTM A416/A416M—2012A

1003-19 Uncoated Stress-Relieved Steel Wire for Prestressed Concrete ASTM A421/A421M—2015

1003-20 Structural Welding Code—Reinforcing Steel AWS D1.4/D1.4M—2011

1003-21 Low and Intermediate Tensile Strength Carbon Steel Plates ASTM A283/A283M—2012A

1003-22 Index of Specifications for Ductile-Iron Pressure Pipe ASTM A377—2018

1003-23 Selecting Proportions for Normal, Heavyweight and Mass Concrete ACI 211.1—1991 (Reapproved 2009)

1003-24 Selecting Proportions for Structural Lightweight Concrete ACI 211.2—1998 (Reapproved 2004) The following Standards appearing in other Sections also shall apply to Section 1004:

EPCOT Standard Number	Author Designation and Year of Publication
1003-25 Evaluation of Strength Test Results of Concrete	ACI 214R—2011

1003-26 Making and Curing Concrete Test Specimens in the Laboratory	ASTM C192/C192M—2018	1003-16	ASTM A82—2002
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1003-27 Sampling Freshly Mixed Concrete	ASTM C172—2010	1003-17	ASTM A185/A185M—2006 (2011)
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1003-28 Compressive Strength of Cylindrical Concrete Specimens	ASTM C39—2018	1003-20	AWS/D1.4M—2011
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1003-29 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete	ASTM C42/C42M—2018a	1007-9	ASTM C28/C28M—2010
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1003-30 Splitting Tensile Strength of Cylindrical Concrete Specimens	ASTM C496/C496M—2017	1009-20	ASTM A242/A242M—2013
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Section 1005—Glass and Glazing			
1003-31 Ready-Mixed Concrete	ASTM C94/C94M—2013	1005-1	Architectural Glazing Material CPSC16-CFR, Part 1201—2002

1003-32 Design and Control of Concrete Mixtures	PCA 15th Edition	1005-2	Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test ANSI Z97.1—2014
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The following Standards appearing in other Sections also shall apply to Section 1003:

1005-3	Building Code Requirements for Masonry Structures	ACI 530—2013 ASCE 5—2013 TMS 402—2016
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EPCOT Standard Number	Title of Standard	Author Designation and Year of Publication	Section 1006—Masonry	
1009-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless Specification for Cast-Iron Soil Pipe and Fittings	ASTM A53—2018	1006-1	Building Code Requirements for Masonry Structures ACI 530—2013 ASCE 5—2013 TMS 402—2016

Section 1004—Gypsum Concrete and Precast Gypsum

1004-1	Reinforced Gypsum Concrete	EPCOT Compilation	1006-2	Masonry Structures ACI 530.1—2013 ASCE 6—2013 TMS 602—2016
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1004-2	Physical Testing of Gypsum, Gypsum Plaster and Gypsum Concrete	ASTM C472—1999 (2009)	1006-3	Building Brick (Solid Masonry Units Made from Clay or Shale) ASTM C62—2013
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1004-3	Physical Testing of Gypsum Panel Products	ASTM C473—2012	1006-4	Calcium Silicate Brick (Sand-Lime Brick) ASTM C73—2010
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1004-4	Gypsum Concrete	ASTM C317/C317M—2000 (2010)	1006-5	Facing Brick (Solid Masonry Units Made from Clay or Shale) ASTM C216—2013
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1004-5	Chemical Analysis of Gypsum and Gypsum Products	ASTM C471M—2001	1006-6	Concrete Building Brick ASTM C55—2011
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1006-7	Load-Bearing Concrete Masonry Units	ASTM C90—2014
1006-8	Reserved	
1006-9	Nonloadbearing Concrete Masonry Units	ASTM C129—2017

APPENDIX A—ADOPTION OF THE APPENDICES AND REFERENCED STANDARDS OF THE EPCOT BUILDING CODE

1006-10	Structural Clay Loadbearing Wall Tile	ASTM C34—2017	1003-13	ASTM A616—1979
1006-11	Structural Clay Nonload-bearing Tile	ASTM C56—2017	1003-14	ASTM A617—1979
1006-13	Ceramic Glazed Structural Clay Facing Tile, Facing Brick and Solid Masonry Units	ASTM C126—2018	1003-15	ASTM A184/A184M—2017
1006-14	Structural Clay Facing Tile	ASTM C212—2017	1003-16	ASTM A82—2007
1006-16	Masonry Cement	ASTM C91/C91M—2012	1003-17	ASTM A185—2007
1006-17	Quicklime for Structural Purposes	ASTM C5—2010	Section 1007—Plastering, Lathing and Installation of Wallboard	
1006-18	Hydrated Lime for Masonry Purposes	ASTM C207—2018	1007-1	(a) Application of Portland Cement-Based Plaster ASTM C926—2015b
1006-19	Finishing Hydrated Lime	ASTM C206—2013		(b) Interior Lathing and Furring ASTM C841—2003 (2008)el
1006-20	Blended Hydraulic Cements	ASTM C595/C595M—2013	1007-2	Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster ASTM C1063—2015a
1006-21	Aggregates for Masonry Mortar	ASTM C144—2018	1007-3	Gypsum Wallboard (Withdrawn) ASTM C36/C36M—2003
1006-22	Aggregates for Masonry Grout	ASTM C404—2018	1007-4	Application and Finishing of Gypsum Panel Products GA 216—2013
1006-23	Mortar for Unit Masonry	ASTM C270—2012a	1007-5	Gypsum Backing Board, Gypsum Coreboard and Gypsum Shaftliner Board (Withdrawn) ASTM C442/C442M—2004
1006-24	Sampling and Testing Brick and Structural Clay Tile	ASTM C67—2013	1007-6	Treated Core and Non-Treated Core Gypsum Sheathing Board ASTM C79—2004a
1006-25	Sampling and Testing Concrete Masonry Units and Related Units	ASTM C140/C140M—2013	1007-7	Gypsum Lath ASTM C37/C37M—2001
1006-26	Packaged, Dry Combined Materials for Surface Bonding Mortar	ASTM C887—2005(2010)	1007-8	Inorganic Aggregates for Use in Gypsum Plaster ASTM C35—1995(2009)
1006-27	Building Brick (Solid Masonry Units Made from Clay or Shale)	ASTM C62—2013	1007-9	Gypsum Plasters ASTM C28/C28M—2010
1006-28	Lightweight Aggregates for Concrete Masonry Units	ASTM C331—2010	1007-10	Gypsum Casting Plaster and Molding Plaster ASTM C59/C59M—2011
1006-29	Grout for Masonry	ASTM C476—2002	1007-11	Finishing Hydrated Lime ASTM C206—2013
1006-30	Sampling and Testing Grout	ASTM C1019—2018	1007-12	Gypsum Keene's Cement ASTM C61/C61M—2000 (2011)

The following Standards appearing in other Sections also shall apply to Section 1006:

EPCOT Standard Number	Author Designation and Year of Publication
1003-3	ASTM C150/C150M—2012
1003-12	ASTM A615/A615M—2012

1007-13	Adhesives for Fastening Gypsum Wallboard to Wood Framing ASTM C557—2003(2009)e01
1007-14	Joint Compound and Joint Tape for Finishing Gypsum Wallboard ASTM C475/C475M—2012

The following Standards appearing in other Sections also shall apply to Section 1007:

**EPCOT
Standard
Number**

**Author Designation
and Year of
Publication**

1003-3

ASTM C150/
C150M—2012

1003-5

ASTM C595/
C595M—2013

1003-15

ASTM A184/
A184M—2006
(2017)

1006-16

ASTM C91/
C91M—2012

Section 1008—Plastics

1008-1 Ignition Temperature
of Plastics

ASTM D1929—
2012

1008-2 Rate of Burning and/or
Extent and Time of Burning
of Plastics in a Horizontal
Position

ASTM D635—
2010

1008-3 Density of Smoke from the
Burning or Decomposition
of Plastics

ASTM D2843—
2010

Section 1009—Steel

1009-1 Structural Steel Buildings
(Supersedes
AISC 335-1989s1)

ANSI/AIS
C360—2010

1009-2 (a) North American
Specification for the
Design of Cold-Formed
Steel Structural Members

AISI S100—
2012

(b) Design of Cold-Formed
Stainless Steel Structural
Members

ASCE 8—2014

1009-3 (a) Open-Web Steel Joists,
K-Series

SJIK—2010

(b) Longspan Steel Joists,
LH-Series and Deep
Longspan Steel Joists,
DLH-Series

SJI LH/
DLH—2010

(c) Load Tables and
Weight Tables for
Steel Joists and Joist
Girders K-Series,
LH-Series, DHL-Series
Joist Girders

SJI 44th
Edition—2015

(d) Code of Standard
Practice for Steel
Joists and Joist Girders

SJI COSP—
2010

1009-4 Structural Applications of
Steel Cables for Buildings

ASCE 19—
2009

1009-5 (a) Structural Welding Code—
Steel AWS D1.1—
2010

(b) Structural Welding Code—
Sheet Steel AWS D1.3—
2008

1009-6 Structural Joints Using
High Strength Bolts RCSC—2009

1009-7 Carbon Structural Steel ASTM A36/
A36M—2008

1009-8 Steel Casting, Carbon, for
General Application ASTM A27/
A27M—2017

1009-9 Gray-Iron Castings ASTM A48/
A48M—2003
(2016)

1009-10 (a) Carbon Steel Electrodes
and Rods for Gas-Shielded
Arc Welding AWS A5.18/
A5.18M—2017

(b) Carbon Steel Electrodes for
Flux-Cored Arc Welding AWS A5.20/
A5.20M—
(R2015)

1009-11 Reserved

1009-12 Pipe, Steel, Black and Hot-
Dipped, Zinc-Coated Welded
and Seamless Specification
for Cast-Iron Soil Pipe
and Fittings ASTM A53—
2018

1009-13 Structural Steel (SS), Sheet,
Carbon, Coil-Rolled
(Withdrawn) ASTM A611—
1997

1009-14 Steel, Sheet and Strip,
Carbon, Hot-Rolled
(Withdrawn) ASTM A570/
A570M—1998

1009-15 Carbon Steel Bolts and Studs,
60,000 psi Tensile Strength ASTM A307—
2014

1009-16 Structural Bolts, Steel,
Heat-Treated, 120/105 ksi
Minimum Tensile Strength ASTM A325—
2009

1009-17 Quenched- and Tempered-
Alloy Steel Bolts, Studs, and
other Externally Threaded
Fasteners ASTM A354-
2017

1009-18 Steel, Sheet and Strip,
High-Strength, Low-Alloy,
Hot-Rolled and Cold-Rolled,
with Improved Atmospheric
Corrosion Resistance ASTM A606/
A606M—2018

1009-19 Steel, Sheet and Strip,
High-Strength, Low-Alloy,
Columbium and/or Vanadium
Hot-Rolled and Cold-Rolled
(Withdrawn 2000) ASTM A607—
1998

1009-20 High-Strength, Low-Alloy
Structural Steel ASTM A242/
A242M—2018

1009-21	High-Strength, Low-Alloy Columbium-Vanadium Structural Steel	ASTM A572/ A572M—2012A	1009-37	High-Strength Carbon- Manganese Steel of Structural Quality	ASTM A529/ A529M—2014
1009-22	Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process, Structural (Physical) Quality (Withdrawn 1994)	ASTM A446/ A446M—1993	1009-38	Steel Joists Shop Primer/Metal Building Primer	SSPC- Paint 15
1009-23	Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use	ASTM A449— 2014	1009-39	Steel Deck Institute Design Manual for Composite Decks, Form Decks and Roof Decks	SDI # 31—2007
1009-24	Heat-Treated Steel Structural Bolts, Alloy Steel, Heat Treated 150 ksi Minimum Tensile Strength	ASTM A490— 2008b	1009-40	Structural Steel Buildings	AISC 360—2010
1009-25	Rivets, Steel, Structural	ASTM A502— 2003(2015)	The following Standards appearing in other Sections apply to the use of steel pipe piles, welding and reinforcing steel:		
1009-26	High-Strength, Low-Alloy Columbium-Vanadium Structural Steel	ASTM A572/ A572M—2012A	EPCOT Standard Number	Author Designation and Year of Publication	
1009-27	Seamless Carbon Steel Pipe for High-Temperature Service	ASTM A106/ A106M—2018	9-6	ASTM A252— 2010	
1009-28	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes	ASTM A500/ A500M—2018	1003-12	ASTM A615/ A615M—2012	
1009-29	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing	ASTM A501— 2014	1003-13	ASTM A616— 1979 (Withdrawn)	
1009-30	Steel Castings, High-Strength for Structural Purposes	ASTM A148/ A148M—2015	1003-14	ASTM A617— 1979 (Withdrawn)	
1009-31	Steel Forgings, Carbon and Alloy, for General Industrial Use	ASTM A668/ A668M—2013el	1003-15	ASTM A184/ A184M—2006 (2017)	
1009-32	High-Strength, Low-Alloy Structural Steel with 50 psi Minimum Yield Point with Atmospheric Corrosion Resistance	ASTM A588/ A588M—2010	1003-16	ASTM A82— 2002	
1009-33	Steel Bars, Carbon, Merchant Quality, Mechanical Properties	ASTM A663/ A633M—2017	1003-17	ASTM A185— 2002	
1009-34	Steel Bars, Carbon, Hot- Wrought, Special Quality, Mechanical Properties	ASTM A675/ A675M—2014	1003-18	ASTM A416/ A416M—2012A	
1009-35	Mechanical Testing of Steel Products	ASTM A370— 2018	1003-19	ASTM A421/ A421M—2015	
1009-36	High-Yield-Strength, Quenched- and Tempered- Alloy Steel Plate, Suitable for Welding	ASTM A514/ A514M—2018	1003-20	AWS D1.4/ D1.4M—2011	
			1003-21	ASTM A283/ A283M—2003 (2012a)	
			1003-22	ASTM A377— 2003 (2018)	
			Section 1010—Wood		
			1010-1	(a) National Design Specifi- cation (NDS) for Wood Construction	ANSI/AWC NDS—2018
				(b) Special Design Provisions for Wind and Seismic	ANSI/AWC SDPWS—2015
			1010-2	(a) Span Tables for Joists and Rafters	AF&PA—2012

	(b) Design Values for Joists and Rafters	AF&PA—2005	(c) Piles—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C3—2003
➡	1010-3 Wood Construction Data Plank and Beam Framing for Residential Buildings	AWC WCD-4—2003	(d) Poles—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C4—2003
➡	1010-4 Structural Glued-Laminated Timber of Softwood Species—Design Requirements—Standard Specifications for Structural Glued-Laminated Timber of Softwood Species—Manufacturing Requirements	AITC 117—2010	(e) Sawn Timber Piles Used to Support Residential and Commercial Structures (Withdrawn)	AWPA C24—2003
	1010-5 Reserved		(f) Posts—Pressure Treatment (Withdrawn)	AWPA C5—2003
	1010-6 Reserved		(g) Plywood—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C9—2003
	1010-7 Reserved		(h) Wood Block for Floors and Platforms Pressure Treatment (Withdrawn)	AWPA C11—2001
	1010-8 Plywood Design Specification (Revised 1998)	APA PDS-Y510J—2004	(i) Wood for Commercial-Residential Construction—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C15—2003
	1010-9 Wood		(j) Round Poles and Posts Used in Building Construction—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C23—2003
➡	1010-10 Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber	ASTM D245—2006(2011)	(k) Structural Glued-Laminated Members and Laminations Before Gluing (Withdrawn)	AWPA C28—2003
➡	1010-11 Grades of Southern and Tidewater Red Cypress	SCMA-June 1, 1986	1010-21 (a) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing	ASTM D2898—2010
	1010-12 Southern Pine Inspection Bureau Grading Rules	SPIB—2014	(b) Hygroscopic Properties of Fire-Retardant-Treated Wood and Wood-Base Products	ASTM D3201/D3201M—2013
	1010-13 Standard Grading Rules for West Coast Lumber	WCLIB 17—2004	(c) Structural Lumber, Fire-Retardant Pressure Treatment (Withdrawn)	AWPA C20—2002
➡	1010-14 Grades of California Redwood Lumber	California Redwood Association—2000 Edition	(d) Plywood—Fire-Retardant Treated by Pressure Processes (Withdrawn)	AWPA C27—2002
	1010-15 Western Lumber Grading Rules	WWPA—2011	1010-22 Piles and Poles, Wood (Canceled)	ANSI 05.1—2002
	1010-16 Official Grading Rules for Northern Hardwood and Pine	NHPMA	1010-23 Federal Specification for Insulation Board, Thermal (Cellulosic Fiber) (Canceled)	LLL-1-535B—1977
	1010-17 Standard Grading Rules for Northeastern Lumber	NeLMA—2013		
➡	1010-18 Structural Glued-Laminated Timber	ANSI A-190.1—2012		
	1010-19 Structural Plywood	NIST—2009		
	1010-20 (a) All Timber Products—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C1—2003		
	(b) Lumber, Timber, Bridge Ties and Mine Ties—Preservative Treatment by Pressure Processes (Withdrawn)	AWPA C2—2002		

1010-24	Fiberboard Nail-Base Sheathing (Withdrawn 1992)	ASTM D2277— 1987	The following Standard referenced in other Sections shall also apply to Section 1010:	
1010-25	Federal Specifications for Nails, Brads, Staples and Spikes: Wire, Cut and Wrought	FF-N-105B— March 17, 1971	EPCOT Standard Number	Author Designation and Year of Publication
1010-26	Cellulostic Fiber Insulating Board	ASTM C208— 2012	6-3	ASTM E84— 2013A
		ASTM C209— 1998	7-8	EPCOT Compilation
1010-27	(a) Basic Hardboard	AHA A 135.4— 2012	9-4	ASTM D2899— 2017
	(b) Prefinished Hardboard Paneling	AHA A 135.5— 2012	9-5	ASTM D25— 2012
	(c) Hardboard Siding	AHA A 135.6— 2012	1007-1	ASTM C926— 2015b
1010-28	Particleboard	ANSI A208.1— 2009	Section 1011—Thermal Insulating Material	
1010-29	Evaluating Properties for Wood-Base Fiber and Particle Panel Materials	ASTM D1037— 2012	1011-1	<i>EPCOT Energy Efficiency Code for Building Construction</i> 2018
1010-30	APA Engineered Wood Construction Guide, Form E30	APA EWCG	1011-2	Energy Standard for Buildings, Except Low-Rise Residential Buildings, I-P Edition ANSI/ ASHRAE/ IESNA 90.1— 2016
1010-31	National Design Standard for Metal-Plate-Connected Wood Truss Construction	TPI 1—2014	1011-3	Advanced Energy Design Guide for Small Office Buildings (Guide) ANSI/ ASHRAE— 2004
1010-32	Performance Standards and Policies for Structural-Use Panels	APA PRP-108	Appendix D—Regulation of Signs and Outdoor Advertising Structures	
1010-33	Adhesives for Field-Glueing Plywood to Wood Framing	APA AFG-01— March 1991	D-1	Standard for Electric Signs UL 48—2011
1010-34	Wood Construction Data No. 6, Design of Wood Frame Structures for Permanence	AF&PA WCD6—2006	D-2	Enclosures for Electrical Equipment, Non-Environmental Considerations UL 50—2015
1010-35	Test Method for Evaluating the Flexural Properties of Fire-Retardant-Treated Softwood Plywood Exposed to the Elevated Temperatures	ASTM D5516— 2009	Appendix N—Regulations for Membrane Structures and Tents	
			N-1	Standard Practice for Design, Manufacture, Operation, and Maintenance of Inflatable Amusement Devices ASTM F2374— 2017
1010-36	Technical Report No. 7, The Permanent Wood Foundation System (Replaced)	AF&PA TR 7— March 1987	Appendix R—Swimming Pools and Bathing Places	
1010-37	Zinc Coating (Hot-Dip) on Iron and Steel Hardware	ASTM A153/ A153M—2009	R-1	Equipment for Pools, Spas, Hot Tubs and Other Recreational Water Facilities NSF/ANSI 50— 2011
1010-38	Coatings of Zinc Mechanically Strip Deposited on Iron and Steel for Building Construction	ASTM B695— 2004(2009)	R-2	Safety Covers and Labeling Requirements for All Covers for Swimming Pools, Spas and Hot Tubs ASTM F1346— 1991(2010)
			R-3	Public Swimming Pools ANSI/NSPI-1— 2003
			R-4	Public Spas ANSI/NSPI-2— 1999

➔	R-5	Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs and Catch Basins	ANSI/APSP-7—2013
	R-6	Drinking Water Treatment Chemicals – Health Effects	NSF/ANSI 60—2005
	R-7	Dimensional Standards	National Collegiate Athletic Association—1998
	R-8	Federation Internationale de Natation Amateur Handbook	FINA 1998—2000
	R-9	Official Rules of Diving & Code Regulation of United States Diving, Inc.	1998—1999
	R-10	United States Swimming Rules and Regulations	1998
	R-11	National Federation of State High School Associations	1997-1998
	R-12	Federation Internationale de Natation Amateur Handbook	FINA 2005-2009
	R-13	National Electrical Code	NFPA 70—2014
	R-14	Suction Fitting for use in Pools, Wading Pools, Spas, Hot Tubs and Whirlpool Bathtub Appliances	ASME/ANSI A112.19.8—2007
	R-15	USEPA Ultraviolet Disinfectant Guidance Manual	EPA 815-R-06-007-Nov. 2006

EPCOT Standard 5-1

➔	5-1-1	Safety Code for Elevators and Escalators—with A17.1a/CSA B44	ASME A17.1—2013
	5-1-2	Guide for Inspection of Elevators, Escalators, and Moving Walks	ASME A17.2—2012
	5-1-3	Safety Standard for Belt Manlifts	ASME A90.1—2009
	5-1-4	Safety Standard for Conveyors, and Related Equipment	ASME B20.1—2009
	5-1-5	Safety Code for Existing Elevators and Escalators	ASME A17.3—1996
	5-1-6	Safety Standard for Platform Lifts and Stairway Chairlifts	ASME A18.1—2008
	5-1-7	Elevator and Escalator Electrical Equipment	ASME A17.5

APPENDIX B

FIRE LIMITS

SECTION B-101 GENERAL

B-101.1 Scope. For the purpose of this Code, there shall be no area within the District designated as a Fire District or included within any territory set forth as fire limits.

APPENDIX C

CALCULATED FIRE RESISTANCE

SECTION C-101 CALCULATED FIRE RESISTANCE

C-101.1 General.

C-101.1.1 Scope. These provisions contain procedures by which the fire resistance of specific materials or combinations of materials can be established by calculations. These procedures apply only to the information contained in this Section and shall not be otherwise used.

C-101.1.2 Definitions. For definitions, see Chapter 2.

C-101.2 Concrete assemblies.

C-101.2.1 Concrete walls.

C-101.2.1.1 Cast-in-place or precast walls.

C-101.2.1.1.1 The minimum equivalent thicknesses of cast-in-place or precast concrete walls for fire-resistance ratings of 1 hour to 4 hours are shown in Table C-101.2.1.1. For solid walls with flat vertical surfaces, the equivalent thickness is the same as the thickness. The values in Table C-101.2.1.1 apply to plain, reinforced or prestressed concrete walls.

C-101.2.1.1.2 For hollow-core precast concrete wall panels in which the cores are of constant cross section throughout the length, the equivalent thickness may be calculated by dividing the net cross-sectional area (the gross cross section minus the area of the cores) of the panel by its width.

C-101.2.1.1.3 Where all of the core spaces of hollow-core wall panels are filled with loose-fill material, such as expanded shale, clay or slag, or vermiculite or perlite, the fire-resistance rating of the wall is the same as that of a solid wall of the same concrete type and of the same overall thickness.

C-101.2.1.1.4 The thickness of panels with tapered cross sections shall be that determined at a distance $2t$ or 6 inches, whichever is less, from the point of minimum thickness, where t is the minimum thickness.

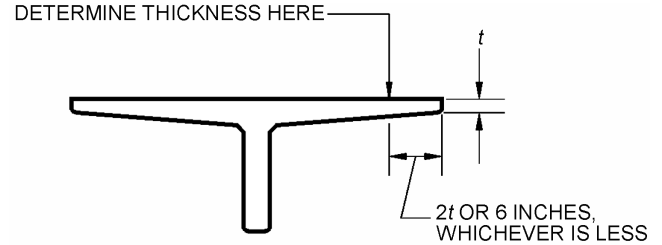


FIGURE C-101.2.1.1.4
THICKNESS OF PANELS WITH TAPERED CROSS SECTIONS

C-101.2.1.1.5 The equivalent thickness of panels with ribbed or undulating surfaces shall be determined by one of the following expressions:

For $s \geq 4t$, the thickness to be used shall be t ;

For $s \leq 2t$, the thickness to be used shall be t_e ;

For $4t > s > 2t$, the thickness to be used shall be

Equation C-101.2.1.1.5 Thickness of Concrete Wall Panels with Ribs

$$t + \left(\frac{4t}{s} - 1 \right) (t_e - t)$$

Where:

s = Spacing of ribs or undulations.

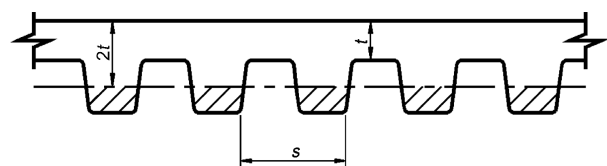
t = Minimum thickness.

t_e = Equivalent thickness of the panel calculated as the net cross-sectional area of the panel divided by the width, in which the maximum thickness used in the calculation shall not exceed $2t$.

TABLE C-101.2.1.1
MINIMUM EQUIVALENT THICKNESS (inches) OF CAST-IN-PLACE
OR PRECAST CONCRETE WALLS, LOAD BEARING OR NONLOAD BEARING

CONCRETE TYPE	1 hour	MINIMUM SLAB THICKNESS (inches) FOR FIRE RESISTANCE RATING OF			
		1½ hours	2 hours	3 hours	4 hours
Siliceous	3.5	4.3	5.0	6.2	7.0
Carbonate	3.2	4.0	4.6	5.7	6.6
Sand-Lightweight	2.7	3.3	3.8	4.6	5.4
Lightweight	2.5	3.1	3.6	4.4	5.1

APPENDIX C—CALCULATED FIRE RESISTANCE



NEGLECT SHADED AREA IN CALCULATION OF EQUIVALENT THICKNESS

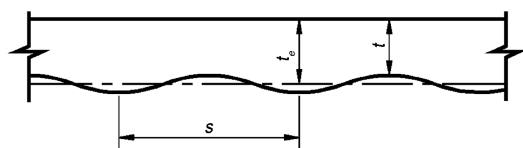
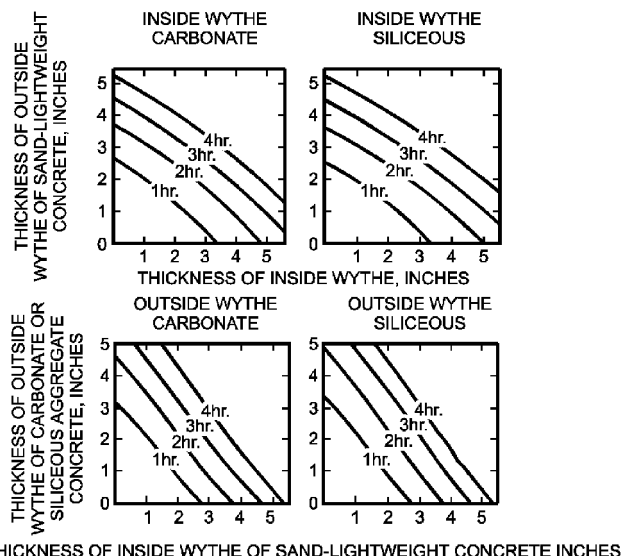


FIGURE C-101.2.1.1.5
THICKNESS OF PANELS WITH RIBBED
OR UNDULATING SURFACES

C-101.2.1.2 Multiwythe walls.

C-101.2.1.2.1. For walls that consist of two wythes of different types of concrete, the fire-resistance ratings may be determined from Figure C-101.2.1.2.

C-101.2.1.2.2. The fire-resistance rating for wall panels consisting of two or more wythes may be determined by the formula:



THICKNESS OF INSIDE WYTHE OF SAND-LIGHTWEIGHT CONCRETE INCHES

FIGURE C-101.2.1.2
FIRE-RESISTANCE RATINGS
OF TWO-WYTHE CONCRETE WALLS

Equation C-101.2.1.2.2 Fire-Resistance Rating for Multiwythe Walls

$$R = (R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59})^{1.7}$$

Where:

R = The fire endurance of the assembly, minutes.

R_1 , R_2 and R_n = The fire endurences of the individual wythes, minutes.

Values of $R_n^{0.59}$ for use in Equation C-101.2.1.2 are given in Table C-101.2.1.2.

TABLE C-101.2.1.2
VALUES OF $R_n^{0.59}$ FOR USE IN EQUATION C-101.2.1.2

TYPE OF MATERIAL	THICKNESS OF MATERIAL (inches)											
	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
Siliceous aggregate concrete	5.3	6.5	8.1	9.5	11.3	13.0	14.9	16.9	18.8	20.7	22.8	25.1
Carbonate aggregate concrete	5.5	7.1	8.9	10.4	12.0	14.0	16.2	18.1	20.3	21.9	24.7	27.2 ^c
Sand-lightweight concrete	6.5	8.2	10.5	12.8	15.5	18.1	20.7	23.3	26.0 ^c	Note c	Note c	Note c
Lightweight concrete	6.6	8.8	11.2	13.7	16.5	19.1	21.9	24.7	27.8 ^c	Note c	Note c	Note c
Insulating concrete ^a	9.3	13.3	16.6	18.3	23.1	26.5 ^c	Note c	Note c	Note c	Note c	Note c	Note c
Air space ^b	—	—	—	—	—	—	—	—	—	—	—	—

a. Dry unit weight of 35 pounds per cubic foot or less and consisting of cellular, perlite or vermiculite concrete.

b. The $R_n^{0.59}$ value for one ½ inch to 3½ inches airspace is 3.3. The $R_n^{0.59}$ value for two ½ inch to 3½ inches airspaces is 6.7.

c. The fire-resistance rating for this thickness exceeds 4 hours.

R , MINUTES	$R^{0.59}$
60	11.20
120	16.85
180	21.41
240	25.37

C-101.2.1.2.3. The fire-resistance ratings of precast concrete wall panels consisting of a layer of foam plastic insulation sandwiched between two wythes of concrete may be determined by use of Equation C-101.2.1.2. Foam plastic insulation with a total thickness of less than 1 inch shall be disregarded. The R_n value for thickness of foam plastic insulation of 1 inch or greater, for use in the calculation, is 5 minutes; therefore, $R_n^{0.59}$ equals 2.5.

C-101.2.1.3 Joints between precast wall panels.

C-101.2.1.3.1 Joints between precast concrete wall panels, which are not insulated as required by this Section, shall be considered as openings in walls. Uninsulated joints shall be included in determining the percentage of openings permitted by Table 6.2. Where openings are not permitted or are required by this Code to be protected, the provisions of this Section shall be used to determine the amount of joint insulation required. Insulated joints shall not be considered openings for purposes of determining compliance with allowable percentage of openings in Table 6.2.

C-101.2.1.3.2 Figure C-101.2.1.3 shows thicknesses of ceramic fiber blankets to be used to insulate joints between precast concrete wall panels for various panel thicknesses and for joint widths of $\frac{3}{8}$ inch and 1 inch for fire-resistance rating of 1 hour to 4 hours. For joint widths between $\frac{3}{8}$ inch and 1 inch the thickness of ceramic fiber blanket may be determined by direct interpolation. Other tested and labeled materials may be used in place of ceramic fiber blankets.

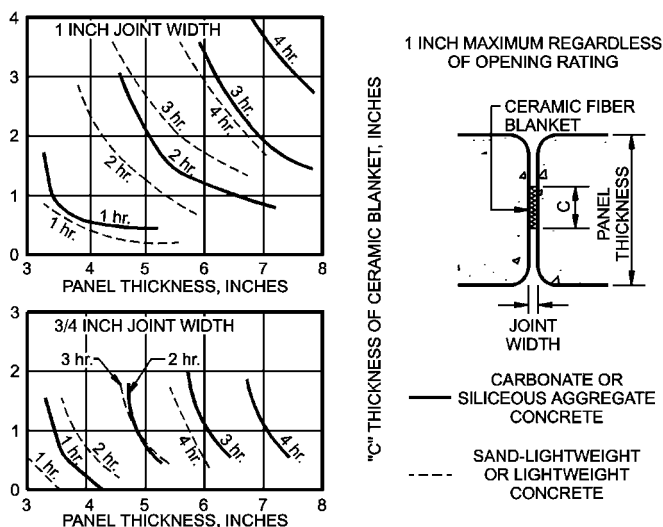


FIGURE C-101.2.1.3
CERAMIC FIBER JOINT PROTECTION

C-101.2.1.4 Walls with gypsum wallboard or plaster finishes.

C-101.2.1.4.1 The fire-resistance rating of cast-in-place or precast concrete walls with finishes of gypsum wallboard or plaster applied to one or both sides may be calculated in accordance with the provisions of this Section.

C-101.2.1.4.2 Where the finish of gypsum wallboard or plaster is applied to the side of the wall not exposed to fire, the contribution of the finish to the total fire resistance rating shall be determined as follows: The thickness of the finish shall first be corrected by multiplying the actual thickness of the finish by the applicable factor determined from Table C-101.2.1.4A based on the type of aggregate in the concrete. The corrected thickness of finish shall then be added to the actual thickness or equivalent thickness of concrete and fire-resistance rating of the concrete and finish determined from Table C-101.2.1.1, Figure C-101.2.1.2 or Table C-101.2.1.2.

C-101.2.1.4.3 Where gypsum wallboard or plaster is applied to the fire-exposed side of the wall, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The time assigned to the finish as established by Table C-101.2.1.4B shall be added to the fire-resistance rating determined from Table C-101.2.1.1, Figure C-101.2.1.2 or Table C-101.2.1.2 for the concrete alone, or to the rating determined in Subsection C-101.2.1.4.2 for the concrete and finish on the nonfire-exposed side.

TABLE C-101.2.1.4A
MULTIPLYING FACTOR FOR FINISHES ON NONFIRE-
EXPOSED SIDE OF WALL

TYPE OF FINISH APPLIED TO WALL	TYPE OF AGGREGATE USED IN CONCRETE OR CONCRETE MASONRY			
	Concrete			
	Siliceous or Carbonate	Sand— Lightweight	Lightweight	
TYPE OF FINISH APPLIED TO WALL	Concrete Masonry			
	Siliceous or Calcareous Gravel Slag	Limestone, Cinders or Unexpanded Slag	Expanded Shale, Clay or Slate	Pumice or Expanded Slag
Portland Cement— Sand Plaster	1.00	0.75 ^a	0.75 ^a	0.50 ^a
Gypsum—Sand Plaster or Gypsum Wallboard	1.25	1.00	1.00	1.00
Gypsum—Vermiculite or Perlite Plaster	1.75	1.50	1.25	1.25

a. For Portland cement-sand plaster $\frac{5}{8}$ inch or less in thickness and applied directly to the concrete masonry on the nonfire-exposed side of the wall, the multiplying factor shall be 1.00.

TABLE C-101.2.1.4B
TIME ASSIGNED TO FINISH MATERIALS ON FIRE-EXPOSED
SIDE OF WALL

FINISH DESCRIPTION	TIME (minutes)
Gypsum Wallboard	
3/8 inch	10
1/2 inch	15
5/8 inch	20
2 layers of 3/8 inch	25
1 layer 3/8 inch, 1 layer 1/2 inch	35
2 layers 1/2 inch	40
Type X Gypsum Wallboard	
1/2 inch	25
5/8 inch	40
Portland Cement-Sand Plaster Applied Directly to Concrete Masonry	See Note a
Portland Cement-Sand Plaster on Metal Lath	
3/4 inch	20
7/8 inch	25
1 inch	30
Gypsum Sand Plaster on 3/8-inch Gypsum Lath	
1/2 inch	35
5/8 inch	40
3/8 inch	50
Gypsum Sand Plaster on Metal Lath	
3/4 inch	50
7/8 inch	60
1 inch	80

a. The actual thickness of Portland cement-sand plaster, provided it is 5/8 inch or less in thickness, may be included in determining the equivalent thickness of the masonry for use in Table C-101.3.1.

C-101.2.1.4.4 For a wall having no finish on one side or having different types or thicknesses of finish on each side, the calculation procedures of Subsections C-101.2.1.4.2 and C-101.2.1.4.3 shall be performed twice, i.e., assume that either side of the wall may be the fire-exposed side. The fire-resistance rating of the wall shall not exceed the lower of the two values.

Exception: For exterior wall with more than 5 feet of horizontal separation, the fire shall be assumed to occur on the interior side only.

C-101.2.1.4.5 When the finish applied to a concrete wall contributes to the fire-resistance rating, the concrete alone shall provide not less than one-half the total required fire-resistance rating.

C-101.2.1.4.6 Finishes on concrete walls, which are assumed to contribute to the total fire-resistance rating of the wall, shall comply with the installation requirements of Subsection C-101.3.1.6.

C-101.2.2 Concrete floor and roof slabs.

C-101.2.2.1 Reinforced and prestressed floors and roofs.

C-101.2.2.1.1 The minimum thicknesses of reinforced and prestressed concrete floor or roof slabs for fire-resistance ratings of 1 hour to 4 hours are shown in Table C-101.2.2.1.

TABLE C-101.2.2.1
MINIMUM SLAB THICKNESS (inches)

CONCRETE TYPE	FIRE-RESISTANCE RATING				
	1 hour	1 1/2 hours	2 hours	3 hours	4 hours
Siliceous	3.5	4.3	5.0	6.2	7.0
Carbonate	3.2	4.0	4.6	5.7	6.6
Sand-Lightweight	2.7	3.3	3.8	4.6	5.4
Lightweight	2.5	3.1	3.6	4.4	5.1

C-101.2.2.1.2 For hollow-core prestressed concrete slabs in which the cores are of constant cross section throughout the length, the equivalent thickness may be obtained by dividing the net cross-sectional area of the slab, including grout in the joints, by its width.

C-101.2.2.1.3 The thickness of slabs with sloping soffits shall be determined at a distance $2t$ or 6 inches, whichever is less, from the point of minimum thickness, where t is the minimum thickness.

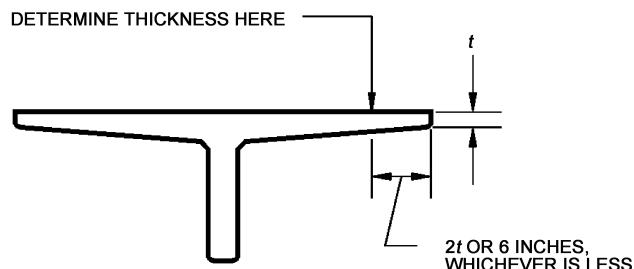


FIGURE C-101.2.2.1.3
THICKNESS OF SLABS WITH SLOPING SOFFITS

C-101.2.2.1.4 The thickness of slabs with ribbed or undulating soffits shall be determined by one of the following expressions, whichever is applicable.

For $s > 4t$, the thickness to be used shall be t ;

For $s \leq 2t$, the thickness to be used shall be t_e ;

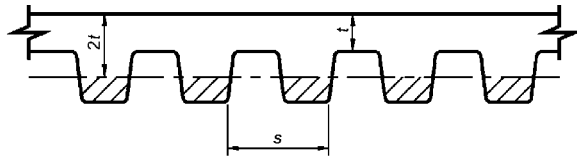
For $4t > s > 2t$, the thickness to be used shall be

Equation C-101.2.2.1.4 Thickness of Concrete Slabs with Ribbed Soffits

$$t + \left(\frac{4t}{s} - 1 \right) (t_e - t)$$

Where:

- s = Spacing of ribs or undulations.
 t = Minimum thickness.
 t_e = Equivalent thickness of the slab calculated as the net area of the slab divided by the width, in which the maximum thickness used in the calculation shall not exceed $2t$.



NEGLECT SHADED AREA IN CALCULATION OF EQUIVALENT THICKNESS

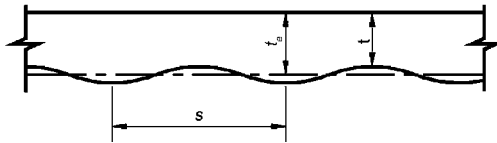


FIGURE C-101.2.2.1.4
THICKNESS OF SLABS WITH RIBBED
OR UNDULATING SOFFITS

C-101.2.2.2 Multicourse floors and roofs.

C-101.2.2.2.1 Figure C-101.2.2A gives information on the fire-resistance ratings of floors that consist of a base slab of concrete with a topping (overlay) of a different type of concrete.

C-101.2.2.2.2 Figure C-101.2.2B.ABC and Figure C-101.2.2B.DE give information on the fire-resistance ratings of roofs that consist of a base slab of concrete with a topping (overlay) of an insulating concrete or with an insulating board and built-up roofing.

- (a) For the transfer of heat, three-ply built-up roofing contributes 10 minutes to the fire-resistance rating; thus, 10 minutes can be added to concrete assemblies such as those shown in Figure C-101.2.2B.ABC, but not to those shown in Figure C-101.2.2B.DE.

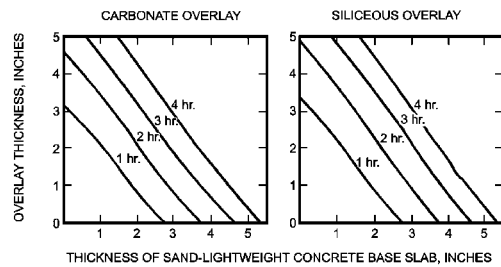
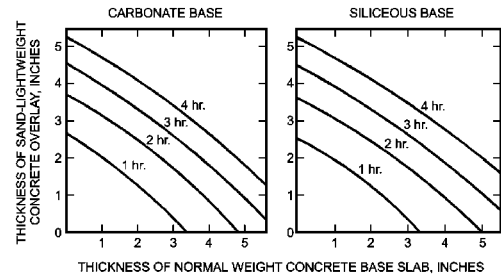
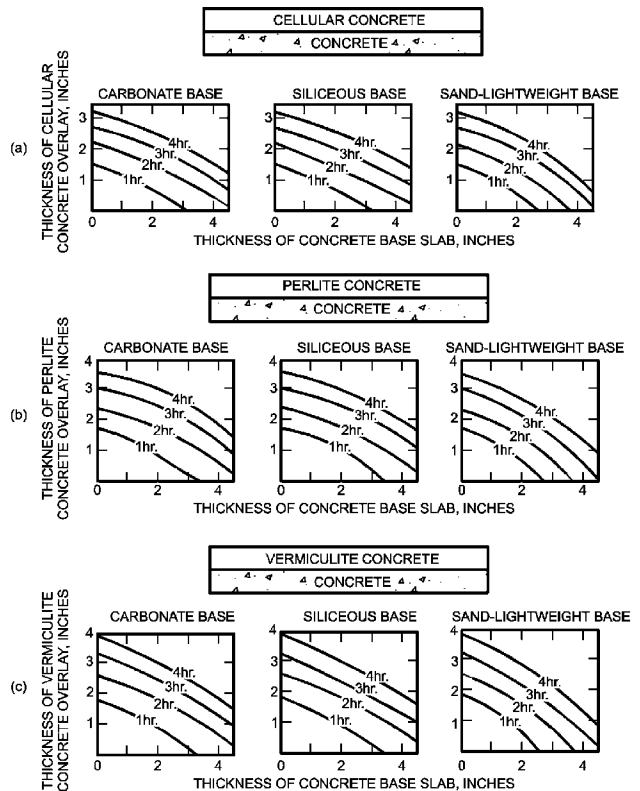


FIGURE C-101.2.2A
FIRE RESISTANCE FOR TWO-COURSE CONCRETE FLOORS



- (a) Thickness of Cellular Concrete Overlay, Inches.
 (b) Thickness of Perlite Concrete Overlay, Inches.
 (c) Thickness of Vermiculite Concrete Overlay, Inches.

FIGURE C-101.2.2B (a, b and c)
FIRE-RESISTANCE RATINGS—
CONCRETE FLOOR ASSEMBLIES

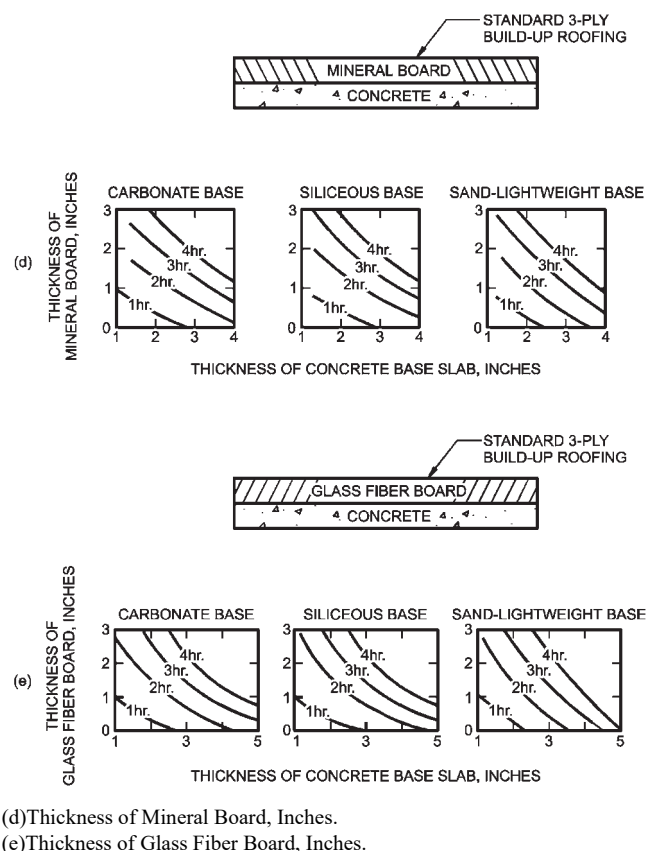


FIGURE C-101.2.2B (d, e)
FIRE-RESISTANCE RATINGS—
CONCRETE FLOOR ASSEMBLIES

C-101.2.2.3 Joints in precast slabs. Joints between adjacent precast concrete slabs may be ignored in calculating the slab thickness provided that a concrete topping at least 1 inch thick is used. Where no concrete topping is used, joints must be grouted to a depth of at least one-third the slab thickness at the joint, but not less than 1 inch, or the joints must be made fire resistant by other approved methods.

C-101.2.3 Concrete cover over reinforcement.

C-101.2.3.1 Slab cover. The minimum thickness of concrete cover to the positive moment reinforcement is given in Table C-101.2.3A for reinforced concrete and Table C-101.2.3B for prestressed concrete. These tables are applicable for solid or hollow-core, one-way or two-way slabs with flat undersurfaces. Slabs may be cast-in-place or precast. For precast, prestressed concrete not covered elsewhere, the procedures contained in *PCI Design for Fire Resistance of Precast Prestressed Concrete* shall be acceptable.

C-101.2.3.2 Reinforced beam cover. The minimum thickness of concrete cover to the positive moment reinforcement (bottom steel) for reinforced concrete beams is shown in Table C-101.2.3C for fire-resistance ratings of 1 hour to 4 hours.

C-101.2.3.3 Prestressed beam cover. The minimum thickness of concrete cover in the positive moment prestressing tendons (bottom steel) for prestressed concrete beams is shown in Table C-101.2.3D for fire-resistance ratings of 1 hour to 4 hours.

TABLE C-101.2.3A
COVER THICKNESS FOR REINFORCED CONCRETE FLOOR OR ROOF SLABS
(inches)

CONCRETE AGGREGATE TYPE	FIRE-RESISTANCE RATING									
	RESTRAINED ^a					UNRESTRAINED ^a				
	1 hour	1½ hours	2 hours	3 hours	4 hours	1 hour	1½ hours	2 hours	3 hours	4 hours
Siliceous	¾	¾	¾	¾	¾	¾	¾	1	1¼	1⅝
Carbonate	¾	¾	¾	¾	¾	¾	¾	¾	1¼	1¼
Sand—Lightweight or Lightweight	¾	¾	¾	¾	¾	¾	¾	¾	1¼	1¼

a. See Subsection C-101.5.2.5.2 for definition of restrained and unrestrained assemblies.

TABLE C-101.2.3B
COVER THICKNESS FOR PRESTRESSED CONCRETE FLOOR OR ROOF SLABS
(inches)

CONCRETE AGGREGATE TYPE	FIRE-RESISTANCE RATING									
	RESTRAINED ^a					UNRESTRAINED ^a				
	1 hour	1½ hours	2 hours	3 hours	4 hours	1 hour	1½ hours	2 hours	3 hours	4 hours
Siliceous	¾	¾	¾	¾	¾	1⅛	1½	1¾	2¾	2¾
Carbonate	¾	¾	¾	¾	¾	1	1¾	1⅝	2⅛	2¼
Sand—Lightweight or Lightweight	¾	¾	¾	¾	¾	1	1¾	1½	2	2¼

a. See Subsection C-101.5.2.5.2 for definitions of restrained and unrestrained assemblies.

TABLE C-101.2.3C
MINIMUM COVER FOR MAIN REINFORCING BARS OF REINFORCED CONCRETE BEAMS^c
(Applicable to All Types of Structural Concrete)

RESTRAINED OR UNRESTRAINED ^a	BEAM WIDTH ^b (inches)	FIRE-RESISTANCE RATING				
		1 hour	1½ hours	2 hours	3 hours	4 hours
Restrained	5	¾	¾	¾	1 ^a	1¼ ^a
	7	¾	¾	¾	¾	¾
	≥ 10	¾	¾	¾	¾	¾
Unrestrained	5	¾	1	1¼	—	—
	7	¾	¾	¾	1¾	3
	≥ 10	¾	¾	¾	1	1¾

a. See Subsection C-101.5.2.5.2 for definitions of restrained and unrestrained assemblies. Tabulated values for restrained assemblies apply to beams spaced more than 4 feet on centers. For restrained beams spaced 4 feet or less on centers, minimum cover of ¾ inch is adequate for ratings of 4 hours or less.

b. For beam widths between the tabulated values, the minimum cover thickness can be determined by direct interpolation.

c. The cover for an individual reinforcing bar is the minimum thickness of concrete between the surface of the bar and the fire-exposed surface of the beam. For beams in which several bars are used, the cover for corner bars used in the calculation shall be reduced to one-half of the actual value. The cover for an individual bar must be not less than one-half of the value given in Table C-101.2.3C, nor less than ¾ inch.

TABLE C-101.2.3D
MINIMUM COVER FOR PRESTRESSED CONCRETE BEAMS^{d, f, g}

RESTRAINED OR UNRESTRAINED ^a	CONCRETE AGGREGATE TYPE ^b	BEAM WIDTH ^c (inches)	FIRE-RESISTANCE RATING				
			1 hour	1½ hours	2 hours	3 hours	4 hours
Restrained	Carb or Sil	8	1½	1½	1½	1¾ ^a	2½ ^a
	Carb or Sil	≥ 12	1½	1½	1½	1½	1¾ ^a
	Sand LW	8	1½	1½	1½	1½	2 ^a
	Sand LW	≥ 12	1½	1½	1½	1½	1⅝ ^a
Unrestrained	Carb or Sil	8	1½	1¾	2½	5 ^e	—
	Carb or Sil	≥ 12	1½	1½	1⅞	2½	3
	Sand LW	8	1½	1½	2	3¼	—
	Sand LW	≥ 12	1½	1½	1⅝	2	2½

- a. See Subsection C-101.5.2.5.2 for definitions of restrained and unrestrained assemblies. Tabulated values for restrained assemblies apply to beams spaced more than 4 feet on centers. For restrained beams spaced 4 feet or less on centers, minimum cover of ¾ inch is adequate for 4-hour ratings or less.
- b. Carb = carbonate aggregate concrete; Sil = siliceous aggregate concrete; Sand LW = sand-lightweight concrete.
- c. For beam widths between 8 inches and 12 inches, minimum cover thickness can be determined by direct interpolation.
- d. The cover for an individual tendon is the minimum thickness of concrete between the surface of the tendon and the fire-exposed surface of the beam, except that for ungrouted ducts the assumed cover thickness is the minimum thickness of concrete between the surface of the duct and the surface of the beam. For beams in which several tendons are used, the cover is assumed to be the average of the minimum cover of individual tendons, where the minimum cover for corner tendons used in the calculation shall be reduced to one-half of the actual value. The cover for an individual tendon must be not less than one-half of the value given in Table C-101.2.3D, nor less than 1 inch.
- e. Not practical for 8-inch-wide beam but shown for purposes of interpolation.
- f. For precast, prestressed concrete not covered elsewhere, the procedures contained in *PCI Design for Fire Resistance of Precast Prestressed Concrete* shall be acceptable.
- g. The minimum cover for nonprestressed reinforcing in prestressed concrete beams shall be determined in accordance with the provisions of Table C-101.2.3C.

C-101.2.4 Concrete columns.

C-101.2.4.1 Minimum size. Table C-101.2.4 shows the minimum overall dimensions of reinforced concrete columns for fire-resistance ratings of 1 hour to 4 hours.

C-101.2.4.2 Minimum cover for r/c columns. The minimum cover to the main longitudinal reinforcement in columns for fire-resistance ratings of 1 hour, 1½ hours, 2 hours and 3 hours shall be 1½ inches; for 4 hours, the minimum cover to the main longitudinal reinforcement shall be 2 inches for siliceous aggregate concrete and 1½ inches for carbonate aggregate concrete or sand-lightweight concrete.

C-101.2.4.3 Columns built into walls. The minimum dimensions of Table C-101.2.4 do not apply to a reinforced concrete column that is built into a concrete or masonry wall provided all of the following are met:

- The fire-resistance rating for the wall is equal to or greater than the required rating of the column;
- Openings in the wall are protected in accordance with Table 7.2; and
- The main longitudinal reinforcing in the column has cover not less than that required by Subsection C-101.2.4.2.

C-101.2.4.4 Precast cover units for steel columns. See Subsection C-101.5.1.4.

C-101.3 Concrete masonry.

C-101.3.1 Concrete masonry walls.

C-101.3.1.1 The fire-resistance rating of walls and partitions constructed of concrete masonry units shall be determined from Table C-101.3.1. The rating shall be based on the equivalent thickness of the masonry and type of aggregate used.

C-101.3.1.2 Where plaster or gypsum wallboard is applied to the side of the wall not exposed to fire, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The thickness of gypsum wallboard or plaster shall be corrected by multiplying the actual thickness of the finish by applicable factor deter-

TABLE C-101.2.4
MINIMUM DIMENSION OF CONCRETE COLUMNS
(inches)

TYPES OF CON- CRETE	FIRE-RESISTANCE RATING				
	1 hour	1½ hours	2 hours ^a	3 hours ^a	4 hours ^b
Siliceous	8	9	10	12	14
Carbonate	8	9	10	11	12
Sand-Lightweight	8	8½	9	10½	12

- a. The minimum dimension is permitted to be reduced to 8 inches for rectangular columns with two parallel sides at least 36 inches in length.
- b. The minimum dimension is permitted to be reduced to 10 inches for rectangular columns with two parallel sides at least 36 inches in length.

mined from Table C-101.2.1.4A. This corrected thickness of finish shall be added to the equivalent thickness of masonry and the fire-resistance rating of the masonry and finish determined from Table C-101.3.1.

C-101.3.1.3 Where plaster or gypsum wallboard is applied to the fire-exposed side of the wall, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The time assigned to the finish as established by Table C-101.2.1.4B shall be added to the fire-resistance rating determined in Subsection C-101.3.1.1 for the masonry alone, or in Subsection C-101.3.1.2 for the masonry and finish on the nonfire-exposed side.

C-101.3.1.4 For a wall having no finish on one side or having different types or thicknesses of finish on each side, the calculation procedures of this Section shall be performed twice, i.e., assume that either side may be the fire-exposed side of the wall. The fire-resistance rating of the wall shall not exceed the lower of the two values calculated.

Exception: For exterior walls with more than 5 feet of horizontal separation, the fire shall be assumed to occur on the interior side only.

C-101.3.1.5 When the finish applied to a concrete masonry wall contributes to the fire-resistance rating, the masonry alone shall provide not less than one-half the total required fire-resistance rating.

C-101.3.1.6 Installation of finishes shall be as follows:

- (a) Gypsum wallboard and gypsum lath applied to concrete masonry or concrete walls shall be secured to wood or steel furring members spaced not more than 16 inches o.c.
- (b) Gypsum wallboard shall be installed with the long dimension parallel to the furring members and shall have all joints finished.
- (c) Other aspects of the installation of finishes shall comply with the applicable provisions of Chapters 7 and 10.

TABLE C-101.3.1
MINIMUM EQUIVALENT THICKNESS^a (inches) OF BEARING
OR NONBEARING CONCRETE MASONRY WALLS^{b, c, d}

FIRE-RESISTANCE RATING (hours)	TYPE OF AGGREGATE			
	Pumice or Expanded Slag	Expanded Shale, Clay or Slate	Limestone, Cinders or Unexpanded Slag	Calcareous or Siliceous Gravel
0.50	1.5	1.8	1.9	2.0
0.75	1.9	2.2	2.3	2.4
1	2.1	2.6	2.7	2.8
1.25	2.5	2.9	3.1	3.2
1.50	2.7	3.3	3.4	3.6
1.75	3.0	3.4	3.7	3.9
2	3.2	3.6	4.0	4.2
2.25	3.4	3.8	4.3	4.5
2.50	3.6	4.0	4.5	4.8
2.75	3.8	4.2	4.8	5.0
3	4.0	4.4	5.0	5.3
3.25	4.2	4.6	5.2	5.5
3.50	4.4	4.8	5.5	5.8
3.75	4.5	4.9	5.7	6.0
4	4.7	5.1	5.9	6.2

a. Equivalent thickness is the average thickness of the solid material in the unit. Determine the equivalent thickness in accordance with ASTM C140.

b. Values between those shown in the table can be determined by direct interpolation.

c. Where combustible members are framed into the wall, the thickness of solid material between the end of each member and the opposite face of the wall, or between members set in from opposite sides, shall not be less than 93 percent of the thickness shown in the table.

d. Requirements of ASTM C55, ASTM C73 or ASTM C90 shall apply.

C-101.3.2 Filled core spaces. The equivalent thickness of filled hollow concrete masonry is the actual thickness of the unit when loose-fill materials are: sand, pea gravel, crushed stone or slag that meet ASTM C33 requirements; pumice, scoria, expanded shale, expanded clay, expanded slate, expanded slag, expanded fly ash or cinders in compliance with ASTM C331; perlite or vermiculite that complies with ASTM C332 requirements.

C-101.3.3 Multiwythe masonry walls. The fire-resistance rating of wall assemblies constructed of multiple wythes of masonry materials may be based upon the fire-resistance rating period of each wythe and the continuous airspace between each wythe in accordance with the following formula:

Equation C-101.3.3 Fire Resistance of Multiwythe Masonry Wall Assemblies

$$R_A = (R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59} + A_1 + A_2 + \dots + A_n)^{1.7}$$

Where:

R_A = Fire-endurance rating of the assembly, hours.

R_1, R_2, \dots, R_n = Fire-endurance rating of wythes for 1, 2, n (hours), respectively.

A_1, A_2, \dots, A_n = 0.30, factor for each continuous airspace for 1, 2, \dots, n , respectively, having a depth of $\frac{1}{2}$ inch or more between wythes.

C-101.3.4 Concrete masonry lintels. Fire-resistance ratings for concrete masonry lintels shall be determined based upon the nominal thickness of the lintel and the minimum thickness of concrete masonry or concrete, or any combination thereof, covering the main reinforcing bars, as determined according to Table C-101.3.4, or by approved alternative methods.

TABLE C-101.3.4
MINIMUM COVER OF LONGITUDINAL
REINFORCEMENT IN FIRE-RESISTANCE RATED
REINFORCED CONCRETE MASONRY LINTELS
(inches)

NOMINAL WIDTH OF LINTEL (inches)	FIRE-RESISTANCE RATING			
	1 hour	2 hours	3 hours	4 hours
6	1½	2	—	—
8	1½	1½	1¾	3
10 or greater	1½	1½	1½	1¾

C-101.3.5 Concrete masonry columns. Concrete masonry columns shall be designed (and reinforced) in accordance with applicable requirements of this Code. The fire-resistance rating shall be determined based upon the least plan dimension of the column in accordance with Table C-101.3.5 or by approved alternative methods.

TABLE C-101.3.5
MINIMUM DIMENSION (inches)
OF CONCRETE MASONRY COLUMNS

FIRE-RESISTANCE RATING			
1 hour	2 hours	3 hours	4 hours
8	10	12	14

C-101.4 Brick and tile masonry.

C-101.4.1 Clay masonry walls.

C-101.4.1.1 The fire-resistance ratings of walls or partitions constructed of clay masonry units shall be determined from Table C-101.4.1A, C-101.4.1B or C-101.4.1C.

TABLE C-101.4.1A
FIRE-RESISTANCE PERIODS OF BEARING AND NONBEARING
CLAY BRICK MASONRY WALLS OR PARTITIONS^a

WALL OR PARTITION ASSEMBLY (MINIMUM NOMINAL THICKNESS)	MEMBERS FRAMED INTO WALL OR PARTITION	
	Combustible (minutes)	Noncombustible (minutes)
Clay or Shale, Solid 4-inch brick 6-inch brick 8-inch brick 12-inch brick	— — 120 240	75 153 240 —
Clay or Shale, Hollow 8-inch brick, 71 percent solid 60 percent solid, cells filled with loose-fill insulation 12-inch brick 64 percent solid	120 — —	180 240 240
Clay or Shale, Rolok 8-inch Hollow Rolok 12-inch Hollow Rolok 8-inch Hollow Rolok Bak	60 180 —	150 240 240
Cavity Walls, Clay or Shale 8-inch wall two 3-inch (actual) brick wythes separated by 2-inch airspace; masonry joint reinforcement spaced 16 inches o.c. vertically 9-inch wall two nominal 4-inch wythes separated by 2-inch airspace; 1/4-inch metal ties for each 3 square feet of wall area	— 60 ^b	180 240
Clay or Shale Brick, Metal Furring Channels 5-inch wall 4-inch nominal brick (75 percent solid) backed with a hat-shaped metal furring channel 3/4-inch thick formed from 0.021-inch sheet metal attached to brick wall on 24-inch centers with approved fasteners; and 1/2-inch Type X gypsum board attached to the metal furring strips with 1-inch- long Type S screws spaced 8 inches on centers	—	120
Hollow Clay Tile, Brick Facing 8-inch wall 4-inch units (40 percent solid) ^c plus 4-inch solid brick 12-inch wall 8-inch units (40 percent solid) ^c plus 4-inch solid brick	60 120	210 240

a. Units shall comply with the requirements of ASTM C62, ASTM C126, ASTM C216 or ASTM C652.

b. A 9-inch wall has a 120-minute rating if the hollow spaces near combustible members are filled with fire-resistant materials for the full thickness of the wall and for at least 4 inches above, below and between the combustible members.

c. Units shall comply with the requirements of ASTM C34.

TABLE C-101.4.1B
FIRE-RESISTANCE PERIODS OF BEARING AND NONBEARING
CLAY TILE MASONRY WALLS OR PARTITIONS^a

WALL OR PARTITION ASSEMBLY (MINIMUM NOMINAL THICKNESS)	MEMBERS FRAMED INTO WALL OR PARTITION	
	Combustible (minutes)	Noncombustible (minutes)
Hollow Clay Tile		
8-inch unit		
2 cells in wall thickness, 40 percent solid	45	75
2 cells in wall thickness, 43 percent solid	45	90
2 cells in wall thickness, 46 percent solid	60	105
2 cells in wall thickness, 49 percent solid	75	120
3 or 4 cells in wall thickness, 40 percent solid	45	105
3 or 4 cells in wall thickness, 43 percent solid	45	120
3 or 4 cells in wall thickness, 53 percent solid	75	180
3 or 4 cells in wall thickness, 48 percent solid	60	150
12-inch unit		
3 cells in wall thickness, 40 percent solid	120	150
3 cells in wall thickness, 45 percent solid	150	180
3 cells in wall thickness, 49 percent solid	180	210
12-inch wall		
2 units with 3 or 4 cells in wall thickness, 40 percent solid	120	210
2 units with 3 or 4 cells in wall thickness, 45 percent solid	150	240
2 units with 3 or 4 cells in wall thickness, 53 percent solid	180	240
16-inch wall		
2 or 3 units with 4 or 5 cells in wall thickness, 40 percent solid	240	240
Structural Clay Tile		
4-inch unit		
1 cell in wall thickness, 40 percent solid ^{b, c}	—	75
1 cell in wall thickness, 40 percent solid ^{c, d}	—	75
6-inch unit		
1 cell in wall thickness, 30 percent solid ^{b, c}	—	120
1 cell in wall thickness, 30 percent solid ^{c, d}	—	120
2 cells in wall thickness, 45 percent solid ^d	—	60
Hollow Structural Clay Tile		
8-inch unit		
2 cells in wall thickness, 40 percent solid	45	75
2 cells in wall thickness, 49 percent solid	75	120
2 cells in wall thickness, 46 percent solid	60	105
3 or 4 cells in wall thickness, 53 percent solid	75	180
12-inch unit		
3 cells in wall thickness, 40 percent solid	120	150
3 cells in wall thickness, 45 percent solid	150	180
3 cells in wall thickness, 49 percent solid	180	210
12-inch wall		
2 units, with 3 cells in wall thickness, 40 percent solid	120	210
2 units with 3 or 4 cells in wall thickness, 45 percent solid	150	240
16-inch wall		
2 units with 4 cells in wall thickness, 43 percent solid	240	240
2 or 3 units with 4 or 5 cells in wall thickness, 40 percent solid	240	240

a. Units shall comply with the requirements of ASTM C34, ASTM C56, ASTM C212 or ASTM C530.

b. Ratings are for dense hard-burned clay or shale.

c. Cells filled with tile, stone, slag, cinders or sand mixed with mortar.

d. Ratings are for medium-burned clay tile.

TABLE C-101.4.1C
FIRE-RESISTANCE RATINGS FOR BEARING STEEL FRAMED
BRICK VENEER WALLS OR PARTITIONS

WALL OR PARTITION ASSEMBLY	PLASTER SIDE EXPOSED (hours)	BRICK-FACED SIDE EXPOSED (hours)
<p>Outside facing of steel studs: $\frac{1}{2}$-inch wood fiberboard sheathing next to studs, $\frac{3}{4}$-inch airspace formed with $\frac{3}{4}$- × $1\frac{5}{8}$-inch wood strips placed over the fiberboard and secured to the studs; metal or wire lath nailed to such strips, $3\frac{3}{4}$-inch brick veneer held in place by filling $\frac{3}{4}$-inch airspace between the brick and lath with mortar.</p> <p>Inside facing of studs: $\frac{3}{4}$-inch unsanded gypsum plaster on metal or wire lath attached to $\frac{5}{16}$-inch wood strips secured to edges of the studs.</p>	1½	4
<p>Outside facing of steel studs: 1-inch insulation board sheathing attached to studs, 1-inch airspace, and $3\frac{3}{4}$-inch brick veneer attached to steel frame with metal ties every fifth course.</p> <p>Inside facing of studs: $\frac{7}{8}$-inch sanded gypsum plaster (1:2 mix) applied on metal or wire lath attached directly to the studs.</p>	1½	4
<p>Same as above except use $\frac{7}{8}$-inch vermiculite - gypsum plaster or 1-inch sanded gypsum plaster (1:2 mix) applied to metal or wire.</p>	2	4
<p>Outside facing of steel studs: $\frac{1}{2}$-inch gypsum sheathing board, attached to studs, and $3\frac{3}{4}$-inch brick veneer attached to steel frame with metal ties every fifth course.</p> <p>Inside facing of studs: $\frac{1}{2}$-inch sanded gypsum plaster (1:2 mix) applied to $\frac{1}{2}$-inch perforated gypsum lath securely attached to studs and having strips of metal lath 3 inches wide applied to all horizontal joints of gypsum lath.</p>	2	4

C-101.4.1.2 Where plaster is applied to the wall, the total fire-resistance rating shall be determined by the formula:

Equation C-101.4.1.2 Fire Resistance of Clay Masonry Walls with Plaster

$$R = (R_n^{0.59} + pl)^{1.7}$$

Where:

R = The fire endurance of the assembly, hours.

R_n = The fire endurance of the individual wall, hours.

pl = Coefficient for thickness of plaster.

Values for $R_n^{0.59}$ for use in Equation C-101.4.1.2 are given in Table C-101.4.1D. Coefficients for thickness of plaster shall be selected from Table C-101.4.1E based on the actual thickness of plaster applied to the wall or partition and whether one or two sides of the wall are plastered.

TABLE C-101.4.1D
VALUES OF $R_n^{0.59}$
(For Use in Equation C-101.4.1.2,
C-101.4.1.3 or C-101.4.3)

R (hours)	$R_n^{0.59}$
1	1.0
2	1.50
3	1.91
4	2.27

TABLE C-101.4.1E
COEFFICIENTS FOR PLASTER^a

THICKNESS OF PLASTER (inch)	ONE SIDE	TWO SIDE
$\frac{1}{2}$	0.3	0.6
$\frac{5}{8}$	0.37	0.75
$\frac{3}{4}$	0.45	0.90

a. Values listed in table are for 1:3 sanded gypsum plaster.

C-101.4.1.3 Where a continuous airspace separates multiple wythes of the wall or partition, the total fire-resistance rating shall be determined by the formula:

Equation C-101.4.1.3 Fire Resistance When Airspace Separates Wythes

$$R = (R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59} + as)^{1.7}$$

Where:

R = The fire endurance of the assembly, hours.

R_1, R_2 and R_n = The fire endurance of the individual wythes, hours.

as = Coefficient for continuous airspace.

Values for $R_n^{0.59}$ for use in Equation C-101.4.1.3 are given in Table C-101.4.1D. The coefficient for each continuous airspace of $\frac{1}{2}$ inch to $3\frac{1}{2}$ inches separating two individual wythes shall be 0.3.

C-101.4.1.4 For a wall having no finish on one side or having different types or thicknesses of finish on each side, the calculation procedures of this Section shall be performed twice, i.e., assume that either side may be the fire-exposed side of the wall. The fire resistance of the wall shall not exceed the lower of the two values determined.

Exception: For exterior walls with more than 5 feet of horizontal separation, the fire shall be assumed to occur on the interior side only.

C-101.4.2 Hollow clay masonry walls. The fire-resistance rating for hollow clay masonry walls and partitions may be determined from Table C-101.4.2 based on the equivalent thickness of the hollow clay masonry units. The fire-resistance rating determined from Table C-101.4.2 may be used in the calculated fire-resistance rating procedures in Subsection C-101.4.1 or C-101.4.3.

C-101.4.3 Multiwythe walls.

C-101.4.3.1 The fire-resistance rating for walls or partitions consisting of two or more dissimilar wythes may be determined by the formula:

Equation C-101.4.3.1 Fire Resistance for Hollow Clay Multiwythe Walls

$$R = (R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59})^{1.7}$$

Where:

R = The fire endurance of the assembly, hours.

R_1, R_2 and R_n = The fire endurance of the individual wythes, hours.

Values for $R_n^{0.59}$ for use in Equation C-101.4.3 are given in Table C-101.4.1D.

C-101.4.3.2 For walls that consist of two or more wythes of different materials (concrete or concrete masonry units) in combination with clay masonry units, the fire resistance rating of the different materials may be determined from Table C-101.2.1.1 for concrete; Table C-101.3.1 for concrete masonry units; or Table C-101.4.1A, C-101.4.1B or C-101.4.1C for clay and tile masonry units.

TABLE C-101.4.2
MINIMUM EQUIVALENT THICKNESS^a (inches) OF BEARING OR NONBEARING CLAY MASONRY WALLS^{b, c}

TYPE OF MATERIAL	FIRE-RESISTANCE RATING			
	1 hour	2 hours	3 hours	4 hours
Hollow brick ^d of clay or shale, not filled	2.3	3.4	4.3	5.0
Hollow brick ^d of clay or shale, grouted or filled with perlite, vermiculite, or expanded shale aggregate	3.0	4.4	5.5	6.6

a. Equivalent thickness is the average thickness of the solid material in the wall. It may be found by taking the total volume of a wall unit, subtracting the volume of core spaces and dividing this by the area of the exposed face of the unit.

(continued)

TABLE C-101.4.2—continued
MINIMUM EQUIVALENT THICKNESS^a (inches) OF BEARING OR NONBEARING CLAY MASONRY WALLS^{b, c}

- b. Values between those shown in the table can be determined by direct interpolation.
- c. Where combustible members are framed in the wall, the thickness of solid material between the end of each member and the opposite face of the wall, or between members set in from opposite sides, shall be not less than 93 percent of the thickness shown in the table.
- d. Requirements of ASTM C652 shall apply.

C-101.5 Steel assemblies.

C-101.5.1 Structural steel columns.

C-101.5.1.1 General.

C-101.5.1.1.1 These procedures establish a basis for determining the fire resistance of column assemblies as a function of the thickness of fire-resistant material and, the weight, W , and heated perimeter, D , of steel columns. As used in these sections, W is the average weight of a structural steel column, in pounds per linear foot. The heated perimeter, D , is the inside perimeter of the fire-resistant material, in inches, as illustrated in Figure C-101.5.1A.

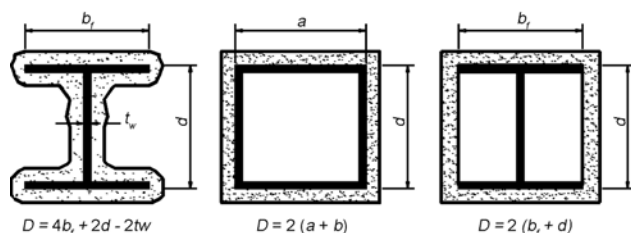


FIGURE C-101.5.1A
DETERMINATION OF THE HEATED PERIMETER OF STRUCTURAL STEEL COLUMNS

C-101.5.1.1.2 The application of these procedures shall be limited to column assemblies in which the fire-resistant material is not designed to carry any of the load acting on the column.

C-101.5.1.1.3 In the absence of substantiating fire-endurance test results, ducts, conduit, piping, and similar mechanical, electrical and plumbing installations shall not be embedded in any required fire-resistant materials.

C-101.5.1.1.4 Table C-101.5.1A contains weight-to-heated-perimeter ratios (W/D) for both contour and box fire-resistant profiles, for the wide flange shapes most often used as columns. For different fire-resistant protection profiles or column cross sections, the weight-to-heated-perimeter ratios (W/D) shall be determined in accordance with the definitions given in this Section.

TABLE C-101.5.1A
W/D RATIOS FOR STEEL COLUMNS

STRUCTURAL SHAPE	CONTOUR PROFILE	BOX PROFILE	STRUCTURAL SHAPE	CONTOUR PROFILE	BOX PROFILE
W14 × 233	2.49	3.65	W10 × 112	1.78	2.57
× 211	2.28	3.35	× 100	1.61	2.33
× 193	2.10	3.09	× 88	1.43	2.08
× 176	1.93	2.85	× 77	1.26	1.85
× 159	1.75	2.60	× 68	1.13	1.66
× 145	1.61	2.39	× 60	1.00	1.48
× 132	1.52	2.25	× 54	0.91	1.34
× 120	1.39	2.06	× 49	0.83	1.23
× 109	1.27	1.88	× 45	0.87	1.24
× 99	1.16	1.72	× 39	0.76	1.09
× 90	1.06	1.58	× 33	0.65	0.93
× 82	1.20	1.68			
× 74	1.09	1.53	W8 × 67	1.34	1.94
× 68	1.01	1.41	× 58	1.18	1.71
× 61	0.91	1.28	× 48	0.99	1.44
× 53	0.89	1.21	× 40	0.83	1.23
× 48	0.81	1.10	× 35	0.73	1.08
× 43	0.73	0.99	× 31	0.65	0.97
			× 28	0.67	0.96
W12 × 190	2.46	3.51	× 24	0.58	0.83
× 170	2.22	3.20	× 21	0.57	0.77
× 152	2.01	2.90	× 18	0.49	0.67
× 136	1.82	2.63			
× 120	1.62	2.36	W6 × 25	0.69	1.00
× 106	1.44	2.11	× 20	0.56	0.82
× 96	1.32	1.93	× 16	0.57	0.78
× 87	1.20	1.76	× 15	0.42	0.63
× 79	1.10	1.61	× 12	0.43	0.60
× 72	1.00	1.48	× 9	0.33	0.46
× 65	0.91	1.35			
× 58	0.91	1.31	W5 × 19	0.64	0.93
× 53	0.84	1.20	× 16	0.54	0.80
× 50	0.89	1.23			
× 45	0.81	1.12	W4 × 13	0.54	0.79
× 40	0.72	1.00			

C-101.5.1.2 Gypsum wallboard protection.

C-101.5.1.2.1 The fire resistance of structural steel columns with weight-to-heated-perimeter ratios (W/D) less than or equal to 3.65 and which are protected with Type X gypsum wallboard may be determined from the following expression:

Equation C-101.5.1.2.1 Gypsum Wallboard Protection

$$R = 130 \left[\frac{h(W'/D)}{2} \right]^{0.75}$$

Where:

R = Fire resistance, minutes.

h = Total thickness of gypsum wallboard, inches.

D = Heated perimeter of the structural steel column, inches.

W' = Total weight of the structural steel column and gypsum wallboard protection, pounds per linear foot; or

$W' = W + 50hD/144.$

C-101.5.1.2.2 The gypsum wallboard shall be supported as illustrated in either Figure C-101.5.1B for fire-resistance ratings of 4 hours or less, or Figure C-101.5.1C for fire-resistance ratings of 3 hours or less.

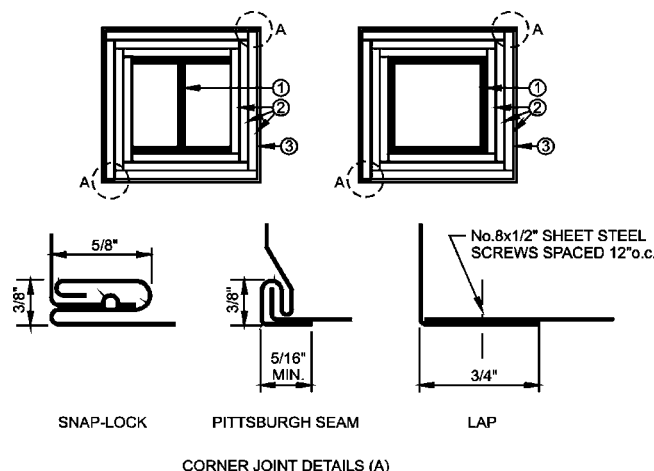


FIGURE C-101.5.1B
GYPSUM WALLBOARD PROTECTED
STRUCTURAL STEEL COLUMNS

Notes:

1. Structural steel column, either wide flange or tubular shapes.
2. Type X gypsum wallboard in accordance with ASTM C36. For single-layer applications, the wallboard shall be applied vertically with no horizontal joints. For multiple-layer applications, horizontal joints are permitted at a minimum spacing of 8 feet provided that the joints in successive layers are staggered at least 12 inches. The total required thickness of wallboard shall be determined on the basis of the specified fire-resistance rating and the weight-to-heated-perimeter ratio (W/D) of the column. For fire-resistance

ratings of 2 hours or less, one of the required layers of gypsum wallboard may be applied to the exterior of the sheet steel column covers with 1-inch-long, Type S screws spaced 1 inch from the wallboard edge and 8 inches on center. For such installations, 0.0149 inch minimum thickness galvanized steel corner beads with 1 1/2-inch legs shall be attached to the wallboard with Type S screws spaced 12 inches on center.

3. For the resistance ratings of 3 hours or less, the column covers shall be fabricated from 0.0239 inch minimum thickness galvanized or stainless steel. For 4 hour fire-resistance ratings, the column covers shall be fabricated from 0.0239 inch minimum thickness stainless steel. The column covers shall be erected with the Snap Lock or Pittsburgh joint details.

For fire-resistance ratings of 2 hours or less, column covers fabricated from 0.0269 inch minimum thickness galvanized or stainless steel may be erected with lap joints. The lap joints may be located anywhere around the perimeter of the column cover. The lap joints shall be secured with 1/2-inch-long, No. 8 sheet metal screws spaced 12 inches on center.

The column covers shall be provided with a minimum expansion clearance of 1/8 inch per linear foot between the ends of the cover and any restraining construction.

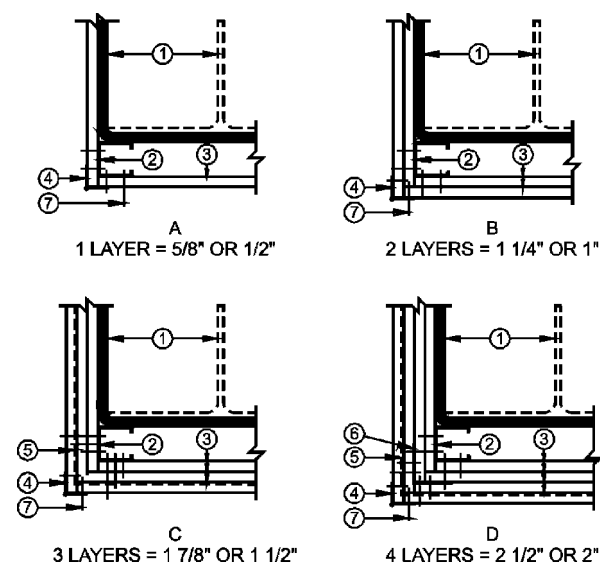


FIGURE C-101.5.1C
GYPSUM WALLBOARD PROTECTED STRUCTURAL STEEL
COLUMNS WITH STEEL STUD/SCREW ATTACHMENT SYSTEM

Notes:

1. Structural steel column, either wide flange or tubular shapes.
2. 1 5/8-inch-deep studs fabricated from 0.0179 inch minimum thickness galvanized steel with 1 5/16- or 1 7/16-inch legs. The length of the steel studs shall be 1/2 inch less than the height of the assembly.
3. Type X gypsum wallboard in accordance with ASTM C36. For single-layer applications, the wallboard shall be applied vertically with no horizontal joints. For multiple-layer applications, horizontal joints are permitted at a minimum spacing of 8 feet provided that the joints in successive layers are staggered at least 12 inches. The total required thickness of wallboard shall be determined on the basis of the specified fire-resistance rating and the weight-to-heated-perimeter ratio (W/D) of the column.
4. Galvanized 0.0149 inch minimum thickness steel corner beads with 1 1/2-inch legs attached to the wallboard with 1-inch-long, Type S screws spaced 12 inches on center.

(continued)

FIGURE C-101.5.1C—continued
GYPSUM WALLBOARD PROTECTED STRUCTURAL STEEL COLUMNS WITH STEEL STUD/SCREW ATTACHMENT SYSTEM

5. No. 18 SWG steel tie wires spaced 24 inches on center.
6. Sheet metal angles with 2-inch legs fabricated from 0.0209 inch minimum thickness galvanized steel.
7. Type S screws 1 inch long shall be used for attaching the first layer of wallboard to the steel studs and the third layer to the sheet metal angles at 24 inches on center. Type S screws 1 3/4 inches long shall be used for attaching the second layer of wallboard to the steel studs and the fourth layer to the sheet metal angles at 12 inches on center. Type S screws 2 1/4 inches long shall be used for attaching the third layer of wallboard to the steel studs at 12 inches on center.

C-101.5.1.2.3 The fire resistance of structural steel columns can be determined from Figure C-101.5.1D for various thicknesses of gypsum wallboard as a function of the weight-to-heated-perimeter ratio (W/D) of the column. For structural steel columns with weight-to-heated-perimeter ratios (W/D) greater than 3.65, the thickness of gypsum wallboard required for specified fire-resistance ratings shall be the same as the thickness determined for a W14 × 233 wide flange shape.

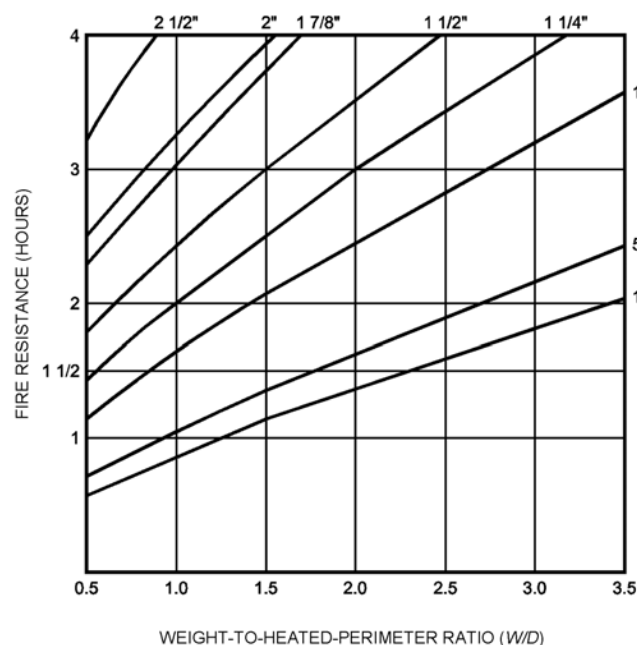


FIGURE C-101.5.1D
FIRE RESISTANCE OF STRUCTURAL STEEL COLUMNS* PROTECTED WITH VARIOUS THICKNESSES OF TYPE X GYPSUM WALLBOARD

- a. The W/D ratios for typical wide flange columns are listed in Table C-101.5.1A. For other column shapes, the W/D ratios shall be determined in accordance with Subsection C-101.5.1.1.

C-101.5.1.3 Spray-applied fire-resistant materials.

C-101.5.1.3.1 The fire resistance of wide flange structural steel columns protected with spray-applied fire-resistant materials, as illustrated in Figure C-101.5.1E, may be determined from the following expression:

Equation C-101.5.1.3.1 Spray-Applied Fire-Resistant Materials

$$R = [C_1(W/D) + C_2] h$$

Where:

- R = Fire resistance, minutes.
 h = Thickness of spray-applied fire-resistant material, inches.
 D = Heated perimeter of the structural steel column, inches.
 C_1 and C_2 = Material-dependent constants.
 W = Weight of structural steel column, pounds per linear foot.

C-101.5.1.3.2 The material-dependent constants, C_1 and C_2 , shall be determined for specific fire-resistant materials on the basis of standard fire-endurance tests in accordance with Chapter 7. Unless evidence is submitted to the building official substantiating a broader application, this expression shall be limited to determining the fire resistance of structural steel columns with weight-to-heated-perimeter ratios (W/D) between the largest and smallest columns for which standard fire-endurance test results are available.

C-101.5.1.3.3 Spray-applied fire-resistant materials shall be identified by density and thickness required for a given fire-resistance rating.

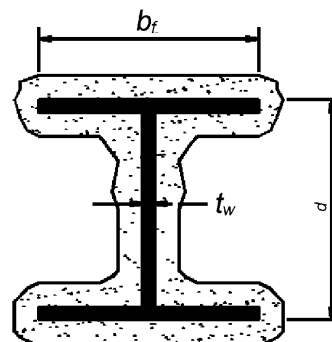


FIGURE C-101.5.1E
WIDE FLANGE STRUCTURAL STEEL COLUMNS WITH SPRAY-APPLIED FIRE RESISTANT MATERIALS

C-101.5.1.4 Concrete-protected columns.

C-101.5.1.4.1 The fire resistance of structural steel columns protected with concrete, as illustrated in Figures C-101.5.1F(a) and C-101.5.1F(b), may be determined from the following expression:

Equation C-101.5.1.4.1 Fire Endurance at Zero Moisture Content

$$R = R_o (1 + 0.03m)$$

Where:

$$R_o = 10(W/D)^{0.7} + 17(h^{1.6} / k_c^{0.2}) \times [1 + 26(H/p_c h (L + h)^{0.8})]$$

As used in these expressions:

R = Fire endurance at equilibrium moisture conditions, minutes.

R_o = Fire endurance at zero moisture content, minutes.

m = Equilibrium moisture content of the concrete by volume, percent.

W = Average weight of the steel column, pounds per linear foot.

D = Heated perimeter of the steel column, inches.

h = Thickness of the concrete cover, inches.

k_c = Ambient temperature thermal conductivity of the concrete, Btu/hr · ft · °F.

H = Ambient temperature thermal capacity of the steel column = 0.11 W , Btu/ft · °F.

p_c = Concrete density, pounds per cubic foot.

c_c = Ambient temperature specific heat of concrete, Btu/lb · °F.

L = Interior dimension of one side of a square concrete box protection, inches.

C-101.5.1.4.2 For wide flange steel columns completely encased in concrete with all re-entrant spaces filled [see Figure C-101.5.1F(c)], the thermal capacity of the concrete within the re-entrant spaces may be added to the thermal capacity of the steel column, as follows:

Equation C-101.5.1.4.2 Added Thermal Capacities of Concrete/Steel Columns

$$H = 0.11W + (p_c c_c / 144)(b_f d - A_s)$$

Where:

b_f = Flange width of the steel column, inches.

d = Depth of the steel column, inches.

A_s = Cross-sectional area of the steel column, square inches.

C-101.5.1.4.3 If specific data on the properties of concrete is not available, the values given in Table C-101.5.1B may be used.

TABLE C-101.5.1B
PROPERTIES OF CONCRETE

PROPERTY	NORMAL WEIGHT CONCRETE	STRUCTURAL LIGHTWEIGHT CONCRETE
Thermal conductivity (k_c)	0.95 Btu/hr · ft · °F	0.35 Btu/hr · ft · °F
Specific heat (c_c)	0.20 Btu/lb · °F	0.20 Btu/lb · °F
Density (P_c)	145 lb/ft ³	110 lb/ft ³
Equilibrium (free) moisture content (m) by volume	4%	5%

C-101.5.1.4.4 For structural steel columns encased in concrete with all re-entrant spaces filled [see Figure C-101.5.1F(c)], Tables C-101.5.1C and C-101.5.1D give the thickness of concrete cover required for various fire-resistance ratings for typical wide flange sections. The thicknesses of concrete given in these tables also apply to structural steel columns larger than those listed.

C-101.5.1.4.5 For structural steel columns protected with precast concrete column covers as shown in Figure C-101.5.1F(a), Table C-101.5.1E gives the thickness of the column covers required for various fire-resistance ratings for typical wide flange shapes. The thicknesses of concrete given in these tables also apply to structural steel columns larger than those listed.

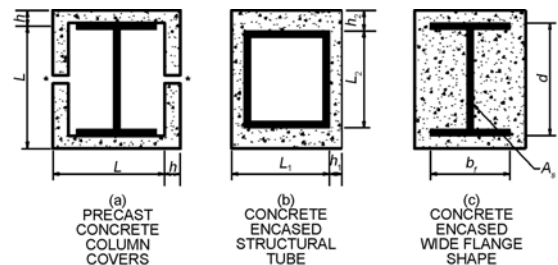


FIGURE C-101.5.1F
CONCRETE PROTECTED STRUCTURAL STEEL COLUMNS^{a, b}

- When the inside perimeter of the concrete protection is not square, L shall be taken as the average of L_1 and L_2 . When the thickness of concrete cover is not constant, h shall be taken as the average of h_1 and h_2 .
- Joints shall be protected with a minimum 1 inch thickness of ceramic fiber blanket but in no case less than one-half the thickness of the column cover (see Subsection C-101.2.1.3).

TABLE C-101.5.1C
MINIMUM COVER (inch) FOR STEEL COLUMNS
ENCASED IN NORMAL WEIGHT CONCRETE^a
[Figure C-101.5.1F(c)]

SHAPE	FIRE-RESISTANCE RATING STRUCTURAL (hours)							
	1	1½	2	3	4			
W14 × 233	1	1	1	1½	2			
× 176				2	2½			
× 132			2					
× 90			1½	2½	3			
× 61								
× 48								
× 43		1½						
W12 × 152	1	1	1	2	2½			
× 96		1½	1½	2½	3			
× 65								
× 50				2½				
× 40								
W10 × 88	1	1½	1½	2	3½			
× 49				3				
× 45	1							
× 39				2½				
× 33				2				
W8 × 67	1	1	1½	2½	3			
× 58		1½						
× 48								
× 31		1½	2	3	3½			
× 21								
× 18								
W6 × 25	1	1½	2	3	3½			
× 20		2	2½					
× 16								
× 15								
× 9	1½		3½	4				

a. The tabulated thicknesses are based upon the assumed properties of normal weight concrete given in Table 709.5.1B.

TABLE C-101.5.1D
MINIMUM COVER (inch) FOR STEEL COLUMNS
ENCASED IN STRUCTURAL LIGHTWEIGHT CONCRETE^a
[Figure C-101.5.1F(c)]

STRUCTURAL SHAPE	FIRE-RESISTANCE RATING (hours)				
	1	1½	2	3	4
W14 × 233	1	1	1	1	1½
× 193				1½	
× 74					2½
× 61			1½	2	
× 43					2
W12 × 65	1	1	1	1½	2
× 53			1½	2	2½
× 40					
W10 × 112	1	1	1	1½	2
× 88				2	2½
× 60			1½		
× 33				1½	2
W8 × 35	1	1	2		
× 28					2½
× 24					
× 18			1½		

a. The tabulated thicknesses are based upon the assumed properties of structural lightweight concrete given in Table 709.5.1B.

TABLE C-101.5.1E
MINIMUM COVER (inch) FOR STEEL COLUMNS
IN NORMAL WEIGHT PRECAST COVERS^a
[Figure C-101.5.1F(a)]

STRUCTURAL SHAPE	FIRE-RESISTANCE RATING (hours)				
	1	1½	2	3	4
W14 × 233	1½	1½	1½	2½	3
× 211			2	3	3½
× 176					
× 145		2	2½	3	4
× 109					
× 99					
× 61				3½	4½
× 43					
W12 × 190	1½	1½	1½	2½	3½
× 152			2	3	4
× 120					
× 96		2	2½	3½	4½
× 87					
× 58					
× 40					
W10 × 112	1½	1½	2	3	3½
× 88		2	2½	3½	4½
× 77					
× 54					
× 33					
W 8 × 67	1½	1½	2	3	4
× 58		2	2½	3½	4½
× 48					
× 28					
× 21		2½	3	4	4½
× 18					
W 6 × 25	1½	2	2½	3½	4½
× 20		2½	3	4	5
× 16					
× 12					
× 9					

a. The tabulated thicknesses are based upon the assumed properties of normal weight concrete given in Table 709.5.1B.

TABLE C-101.5.1F
MINIMUM COVER (inch) FOR STEEL COLUMNS
IN STRUCTURAL LIGHTWEIGHT PRECAST COVERS^a
[Figure C-101.5.1F(a)]

Structural Shape	Fire-Resistance Rating (hours)					
	1	1½	2	3	4	
W14 × 233	1½	1½	1½	2	2½	
× 176				2½	3	
× 145						
× 132						
× 109						
× 99						
× 68			2	3½		
× 43			3			
W12 × 190	1½	1½	1½	2	2½	
× 152				3	3½	
× 136						
× 106			2½			
× 96				2		3
× 87						
× 65			2	3		
× 40						
W10 × 112	1½	1½	2	3		
× 100			2½		3½	
× 88						
× 77						
× 60			2	3		
× 39						
× 33		2				
W8 × 67		1½	1½	1½	2½	3
× 48	2			3	3½	
× 35						
× 28						
× 18	2		2½	4		
W 6 × 25	1½	2	2	3	3½	
× 15			2½	3½	4	
× 9						

a. The tabulated thicknesses are based upon the assumed properties of structural lightweight concrete given in Table 709.5.1B.

C-101.5.1.4.6 The fire resistance of structural steel columns protected with concrete masonry units as illustrated in Figure C-101.5.1G, may be determined from the following expression:

Equation C-101.5.1.4.6 Fire Resistance of Structural Steel Columns

$$R = 0.17(W/D)^{0.7} + [0.285(T_e^{1.6}/K^{0.2})] \\ [1.0 + 42.7\{(A_s/d_m T_e)/(0.25p + T_e)\}^{0.8}]$$

Where:

R = Fire-resistance rating of column assembly, hours.

W = Average weight of steel column, pounds per foot.

D = Heated perimeter of steel column, inches (see Figure C-101.5.1G).

T_e = Equivalent thickness of concrete masonry unit, inches (see Table C-101.3.1, Note a).

APPENDIX C—CALCULATED FIRE RESISTANCE

- K = Thermal conductivity of concrete masonry unit, Btu/hr · ft · °F (see Table C-101.5.1G).
 A_s = Cross-sectional area of steel column, square inches.
 d_m = Density of the concrete masonry unit, pounds per cubic foot.
 p = Inner perimeter of concrete masonry protection, inches (see Figure C-101.5.1G).

TABLE C-101.5.1G
THERMAL CONDUCTIVITY OF CONCRETE MASONRY UNITS

DENSITY (d_m) OF UNITS (lb/ft ³)	THERMAL CONDUCTIVITY (K) OF UNITS (Btu/hr · ft · °F)
80	0.207
85	0.228
90	0.252
95	0.278
100	0.308
105	0.340
110	0.376
115	0.416
120	0.459
125	0.508
130	0.561
135	0.620
140	0.685
145	0.758
150	0.837

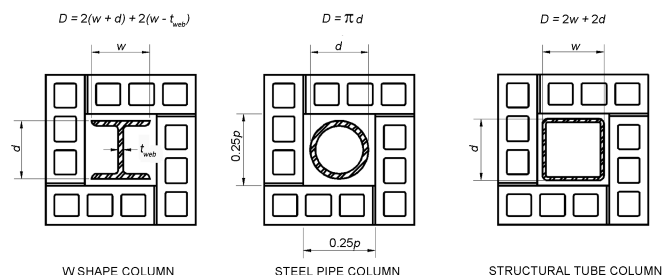


FIGURE C-101.5.1G
CONCRETE MASONRY PROTECTED
STRUCTURAL STEEL COLUMNS

Notes:

- d = Depth of a wide flange column, outside diameter of pipe column, or outside dimension of structural tubing column, inches.
 t_{web} = Thickness of web of wide flange column, inches.
 w = Width of flange of wide flange column, inches.

C-101.5.2 Structural steel beams and girders.

C-101.5.2.1 Determination of fire resistance.

C-101.5.2.1.1 These procedures establish a basis for determining the fire resistance of structural steel beams and girders, which differ in size from that specified in approved fire-resistant assemblies as a

function of the thickness of fire-resistant material and the weight (W) and heated perimeter (D) of the beam or girder.

As used in these sections, W is the average weight of a structural steel member, in pounds per linear foot. The heated perimeter, D , is the inside perimeter of the fire-resistant material, in inches, as illustrated in Figure C-101.5.2.

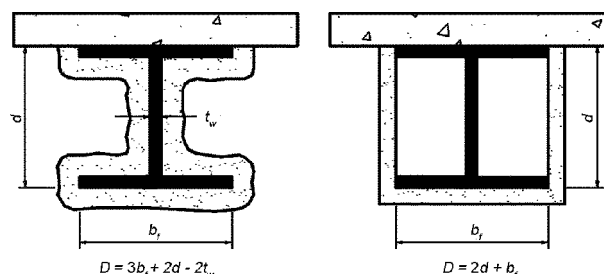


FIGURE C-101.5.2
DETERMINATION OF THE HEATED PERIMETER
OF STRUCTURAL STEEL BEAMS AND GIRDERS

C-101.5.2.1.2 The weight-to-heated-perimeter ratios (W/D), for both contour and box fire-resistant protection profiles, for the wide flange shapes most often used as beams or girders are given in Table C-101.5.2. For different shapes, the weight-to-heated-perimeter ratios (W/D) shall be determined in accordance with the definitions given in this Section.

C-101.5.2.1.3 Except as provided for in Subsection C-101.5.2.2, structural steel beams in approved fire-resistant assemblies shall be considered the minimum permissible size. Other beam or girder shapes may be substituted provided that the weight-to-heated-perimeter ratio (W/D) of the substitute beam is equal to or greater than that of the beam specified in the approved assembly.

C-101.5.2.2 Spray-applied fire-resistant materials.

C-101.5.2.2.1 The provisions in this Section apply to unrestrained structural steel beams and girders protected with spray-applied cementitious or mineral fiber materials. Larger or smaller unrestrained beam and girder shapes may be substituted for beams specified in approved unrestrained or restrained fire-resistant assemblies provided that the thickness of the fire-resistant material is adjusted in accordance with the following expression:

Equation C-101.5.2.2.1 Spray-Applied Fire Protection

$$(h_2 = h_1) \left[\frac{W_1/D_1 + 0.60}{W_2/D_2 + 0.60} \right]$$

Where:

- h = Thickness of spray-applied fire-resistant material, inches.

W = Weight of the structural steel beam or girder, pounds per linear foot.

D = Heated perimeter of the structural steel beam or girder, inches.

Subscript 1 refers to the beam and fire-resistant material thickness in the approved assembly.

Subscript 2 refers to the substitute beam or girder and the required thickness of fire-resistant material.

C-101.5.2.2.2 The equation in Subsection C-101.5.2.2.1 is limited to beams with a weight-to-heated-perimeter ratio (W/D) of 0.37 or greater. The minimum thickness of fire-resistant material shall not be less than $\frac{3}{8}$ inch.

TABLE C-101.5.2
WEIGHT TO HEATED PERIMETER RATIOS (W/D)
FOR TYPICAL WIDE FLANGE BEAM AND GIRDER SHAPES

STRUCTURAL SHAPE	CONTOUR PROFILE	BOX PROFILE
W36 × 300	2.47	3.33
× 280	2.31	3.12
× 260	2.16	2.92
× 245	2.04	2.76
× 230	1.92	2.61
× 210	1.94	2.45
× 194	1.80	2.28
× 182	1.69	2.15
× 170	1.59	2.01
× 160	1.50	1.90
× 150	1.41	1.79
× 135	1.28	1.63
W33 × 241	2.11	2.86
× 221	1.94	2.64
× 201	1.78	2.42
× 152	1.51	1.94
× 141	1.41	1.80
× 130	1.31	1.67
× 118	1.19	1.53
W30 × 211	2.00	2.74
× 191	1.82	2.50
× 173	1.66	2.28
× 132	1.45	1.85
× 124	1.37	1.75
× 116	1.28	1.65
× 108	1.20	1.54
× 99	1.10	1.42
W27 × 178	1.85	2.55
× 161	1.68	2.33
× 146	1.53	2.12
× 114	1.36	1.76
× 102	1.23	1.59
× 94	1.13	1.47
× 84	1.02	1.33
W24 × 162	1.85	2.57
× 146	1.68	2.34
× 131	1.52	2.12
× 117	1.36	1.91
× 104	1.22	1.71
× 94	1.26	1.63
× 84	1.13	1.47
× 76	1.03	1.34
× 68	0.92	1.21
× 62	0.92	1.14
× 55	0.82	1.02

(continued)

TABLE C-101.5.2—continued
WEIGHT TO HEATED PERIMETER RATIOS (W/D)
FOR TYPICAL WIDE FLANGE BEAM AND GIRDER SHAPES

STRUCTURAL SHAPE	CONTOUR PROFILE	BOX PROFILE
W14 × 132	1.83	3.00
× 120	1.67	2.75
× 109	1.53	2.52
× 99	1.39	2.31
× 90	1.27	2.11
× 82	1.41	2.12
× 74	1.28	1.93
× 68	1.19	1.78
× 61	1.07	1.61
× 53	1.03	1.48
× 48	0.94	1.35
× 43	0.85	1.22
× 38	0.79	1.09
× 34	0.71	0.98
× 30	0.63	0.87
× 26	0.61	0.79
× 22	0.52	0.68
W12 × 87	1.44	2.34
× 79	1.32	2.14
× 72	1.20	1.97
× 65	1.09	1.79
× 58	1.08	1.69
× 53	0.99	1.55
× 50	1.04	1.54
× 45	0.95	1.40
× 40	0.85	1.25
× 35	0.79	1.11
× 30	0.69	0.96
× 26	0.60	0.84
× 22	0.61	0.77
× 19	0.53	0.67
× 16	0.45	0.57
× 14	0.40	0.50
W10 × 112	2.14	3.38
× 100	1.93	3.07
× 88	1.70	2.75
× 77	1.52	2.45
× 68	1.35	2.20
× 60	1.20	1.97
× 54	1.09	1.79
× 49	0.99	1.64
× 45	1.03	1.59
× 39	0.94	1.40
× 33	0.77	1.20
× 30	0.79	1.12
× 26	0.69	0.98
× 22	0.59	0.84

(continued)

TABLE C-101.5.2—continued
WEIGHT TO HEATED PERIMETER RATIOS (W/D)
FOR TYPICAL WIDE FLANGE BEAM AND GIRDER SHAPES

STRUCTURAL SHAPE	CONTOUR PROFILE	BOX PROFILE
W21 × 147	1.83	2.60
× 132	1.66	2.35
× 122	1.54	2.19
× 111	1.41	2.01
× 101	1.29	1.84
× 93	1.38	1.80
× 83	1.24	1.62
× 73	1.10	1.44
× 68	1.03	1.35
× 62	0.94	1.23
× 57	0.93	1.17
× 50	0.83	1.04
× 44	0.73	0.92
W18 × 119	1.69	2.42
× 106	1.52	2.18
× 97	1.39	2.01
× 86	1.24	1.80
× 76	1.11	1.60
× 71	1.21	1.59
× 65	1.11	1.47
× 60	1.03	1.36
× 55	0.95	1.26
× 50	0.87	1.15
× 46	0.86	1.09
× 40	0.75	0.96
× 35	0.66	0.85
W16 × 100	1.56	2.25
× 89	1.40	2.03
× 77	1.22	1.78
× 67	1.07	1.56
× 57	1.07	1.43
× 50	0.94	1.26
× 45	0.85	1.15
× 40	0.76	1.03
× 36	0.69	0.93
× 31	0.65	0.83
× 26	0.55	0.70
× 19	0.59	0.78
× 17	0.54	0.70
× 15	0.48	0.63
× 12	0.38	0.51
W8 × 67	1.61	2.55
× 58	1.41	2.26
× 48	1.18	1.91
× 40	1.00	1.63
× 35	0.88	1.44
× 31	0.79	1.29
× 28	0.80	1.24
× 24	0.69	1.07
× 21	0.66	0.96
× 18	0.57	0.84
× 15	0.54	0.74
× 13	0.47	0.65
× 10	0.37	0.51
W6 × 25	0.82	1.33
× 20	0.67	1.09
× 16	0.66	0.96
× 15	0.51	0.83
× 12	0.51	0.75
× 9	0.39	0.57

(continued)

TABLE C-101.5.2—continued
WEIGHT TO HEATED PERIMETER RATIOS (W/D)
FOR TYPICAL WIDE FLANGE BEAM AND GIRDER SHAPES

STRUCTURAL SHAPE	CONTOUR PROFILE	BOX PROFILE
W5 × 19	0.76	1.24
× 16	0.65	1.07
W4 × 13	0.65	1.05

C-101.5.2.3 Structural steel trusses. The fire resistance of structural steel trusses protected with cementitious or mineral fiber materials spray-applied to each of the individual truss elements may be determined in accordance with this Section. The thickness of the fire-resistant material shall be determined in accordance with Subsection C-101.5.1.3. The weight-to-heated-perimeter ratio (W/D) of truss elements, which can be simultaneously exposed to fire on all sides, shall be determined on the same basis as columns, as specified in Subsection C-101.5.1.1. The weight-to-heated-perimeter ratio (W/D) of truss elements, which directly support floor or roof construction, shall be determined on the same basis as beams and girders, as specified in Subsection C-101.5.2.1.

C-101.5.2.4 Determining conditions of restraint. See Table C-101.5.2.5 for guidance on restrained and unrestrained assemblies.

C-101.5.2.5 Determining conditions of restraint.

C-101.5.2.5.1 For the purpose of determining the required fire-resistance rating of floor and roof assemblies, including individual beams, used in steel and concrete construction, such structural elements shall be classified as restrained or unrestrained in accordance with Subsection C-101.5.2.5.

C-101.5.2.5.2 Floor and roof assemblies, and individual beams in buildings, shall be considered restrained when their surrounding or supporting structure is capable of resisting substantial thermal expansion throughout the range of anticipated elevated temperatures. Construction not complying with this definition is assumed to be free to rotate and expand and shall, therefore, be considered as unrestrained. See Table C-101.5.2.5 for determining restrained and unrestrained assemblies.

C-101.6 Wood assemblies.

C-101.6.1 General.

C-101.6.1.1 This Section contains procedures for calculating the fire-resistance ratings of walls, floor/ceiling and roof/ceiling assemblies based, in part, on the standard method of testing referenced in EPCOT Standard 6-1.

C-101.6.1.2 Fire-resistance ratings calculated using the procedures in this Section shall be used only for 1-hour-rated assemblies.

C-101.6.1.3 When dissimilar membranes are used on a wall assembly, the calculation shall be made from the least fire-resistant (weaker) side.

TABLE C-101.5.2.5
CONDITIONS OF RESTRAINT

	CONSTRUCTION	CLASSIFICATION
I.	Wall Bearing:	
	Single-Span and Simply Supported End Spans of Multiple Bays: ^a	
	(1) Open-web steel joists or beams supporting concrete slabs, precast units or metal decking	Unrestrained
	(2) Concrete slabs, precast units or metal decking	Unrestrained
	Interior Spans of Multiple Bays:	
	(1) Open-web steel joists or steel beams supporting precast units or metal decking	Unrestrained
	(2) Open-web steel joists, steel beams or metal decking supporting continuous concrete slab	Restrained
	(3) Cast-in-place concrete slab systems	Restrained
	(4) Precast concrete where the potential thermal expansion is resisted by adjacent construction ^b	Restrained
II.	Steel Framing:	
	(1) Steel beams welded, riveted or bolted to the framing members	Restrained
	(2) All types of cast-in-place floor and roof systems (such as beam-and-slabs, flat slabs, pan joists and waffle slabs) where the floor or roof system is secured to the framing members	Restrained
	(3) All types of prefabricated floor or roof systems where the structural members are secured to the framing members and the potential thermal expansion of the floor or roof system is resisted by the framing system or the adjoining floor or roof construction ^b	Restrained
III.	Concrete Framing:	
	(1) Beams securely fastened to the framing members	Restrained
	(2) All types of cast-in-place floor or roof systems (such as beam-and-slabs, flat slabs, pan joists and waffle slabs) where the floor or roof system is cast with the framing members	Restrained
	(3) Interior and exterior spans of precast systems with cast-in-place joints resulting in restraint equivalent to that which would exist in Condition III(1)	Restrained
	(4) All types of prefabricated floor or roof systems where the structural members are secured to such systems and the potential thermal expansion of the floor or roof systems is resisted by the framing system or the adjoining floor or roof construction ^b	Restrained

a. Floor and roof systems shall be considered restrained when they are tied into walls with or without tie beams, the walls being designed and detailed to resist thermal thrust from the floor or roof system.

b. Resistance to potential thermal expansion is considered to be achieved when:

- (1) Continuous structural concrete topping is used,
- (2) The space between the ends of precast units or between the ends of units and the vertical face of supports is filled with concrete or mortar, or
- (3) The space between the ends of precast units and the vertical faces of supports, or between the ends of solid or hollow core slab units does not exceed 0.25 percent of the length for normal-weight concrete members or 0.1 percent of the length for structural lightweight concrete members.

C-101.6.2 Walls, floors and roofs.

C-101.6.2.1 These procedures apply to both load-bearing and nonload-bearing assemblies.

C-101.6.2.2 The fire-resistance rating of a wood-framed assembly is equal to the sum of the time assigned to the membrane on the fire-exposed side, the time assigned to the framing members and the time assigned for additional contribution by other protective measures, such as insulation. The membrane on the unexposed side shall not be included in determining the fire resistance of the assembly.

C-101.6.2.3 Table C-101.6.2A gives the time-assigned to membranes on the fire-exposed side.

TABLE C-101.6.2A
TIME ASSIGNED TO WALLBOARD MEMBRANES^{a, b, c, d}

DESCRIPTION OF FINISH	TIME (minutes)
$3/8$ -inch wood structural panel bonded with exterior glue	5
$15/32$ -inch wood structural panel bonded with exterior glue	10
$19/32$ -inch wood structural panel bonded with exterior glue	15
$3/8$ -inch gypsum wallboard	10
$1/2$ -inch gypsum wallboard	15
$5/8$ -inch gypsum wallboard	30
$1/2$ -inch Type X gypsum wallboard	25
$5/8$ -inch Type X gypsum wallboard	40
Double $3/8$ -inch gypsum wallboard	25
$1/2$ - + $3/8$ -inch gypsum wallboard	35
Double $1/2$ -inch gypsum wallboard	40

a. These values apply only when membranes are installed on framing members which are spaced 16 inches o.c.

b. Gypsum wallboard installed over framing or furring shall be installed so that all edges are supported, except $5/8$ -inch Type X gypsum wallboard may be installed horizontally with the horizontal joints staggered 24 inches each side and unsupported but finished.

c. On wood-framed floor/ceiling or roof/ceiling assemblies, gypsum board shall be installed with the long dimension perpendicular to framing members and shall have all joints finished.

d. The membrane on the unexposed side shall not be included in determining the fire resistance of the assembly. When dissimilar membranes are used on a wall assembly, the calculation shall be made from the least fire-resistant (weaker) side.

C-101.6.2.4 For an exterior wall having more than 5 feet of horizontal separation, the wall is assigned a rating dependent on the interior membrane and the framing as described in Tables C-101.6.2A and C-101.6.2B. The membrane on the outside or nonfire-exposed side of exterior walls having more than 5 feet of horizontal separation may consist of sheathing, sheathing paper, and siding as described in Table C-101.6.2C.

C-101.6.2.5 In the case of a floor or roof, the standard test provides only for testing for fire exposure from below. Except as noted in Subsection C-101.5.3, floor or roof assemblies of wood framing shall have an upper membrane consisting of a subfloor and finish floor conforming to Table C-101.6.2D or any other membrane that has a contribution to fire resistance of at least 15 minutes in Table C-101.6.2A.

APPENDIX C—CALCULATED FIRE RESISTANCE

C-101.6.2.6 Table C-101.6.2E gives the time increments that can be added to the fire resistance when glass fiber, rockwool or slag mineral wool insulation is incorporated in the assembly.

C-101.6.2.7 Fastening of wood framed assemblies and the fastening of membranes to the wood framing members shall be done in accordance with EPCOT Standard 1010-9.

TABLE C-101.6.2B
TIME ASSIGNED FOR CONTRIBUTION
OF WOOD FRAME^{a, b, c}

DESCRIPTION	TIME ASSIGNED TO FRAME (minutes)
Wood studs 16 inches o.c.	20
Wood floor and roof joists 16 inches o.c.	10

- a. This table does not apply to studs or joists spaced more than 16 inches o.c.
b. All studs shall be nominal 2 × 4 and all joists shall have a nominal thickness of at least 2 inches.
c. Allowable spans for joists shall be determined in accordance with Chapter 9.

TABLE C-101.6.2C
MEMBRANE^a ON EXTERIOR FACE OF WOOD STUD WALLS

SHEATHING	PAPER	EXTERIOR FINISH
5/8-inch T & G lumber		Lumber siding
5/16-inch exterior glue plywood	Sheathing paper	Wood shingles and shakes
1/2-inch gypsum wallboard		1/4-inch wood structural panels—exterior type
5/8-inch gypsum wallboard		1/4-inch hardboard
1/2-inch fiberboard		Metal siding Stucco on metal lath Masonry veneer
None		3/8-inch exterior grade wood structural panels

- a. Any combination of sheathing, paper and exterior finish listed may be used.

TABLE C-101.6.2D
FLOORING OR ROOFING OVER WOOD FRAMING^a

ASSEMBLY	STRUCTURAL MEMBERS	SUBFLOOR OR ROOF DECK	FINISH FLOORING OR ROOFING
			Hardwood or softwood flooring on building paper.
Floor	Wood	15/32-inch wood structural panels or 11/16-inch T & G softwood	Resilient flooring, parquet floor felted-synthetic-fiber floor coverings, carpeting, or ceramic tile on 3/8-inch-thick panel-type underlay Ceramic tile on 1 1/4-inch mortar bed
Roof	Wood	15/32-inch wood structural panels or 11/16-inch T & G softwood	Finish roofing material with or without insulation

- a. This table applies only to wood joist construction. It is not applicable to wood truss construction.

TABLE C-101.6.2E
TIME ASSIGNED FOR ADDITIONAL PROTECTION

DESCRIPTION OF ADDITIONAL PROTECTION	RESISTANCE (minutes)
Add to the fire-resistance rating of wood stud walls if the spaces between the studs are completely filled with glass fiber mineral wool batts weighing not less than 2 pounds per cubic foot (0.6 pound per square foot of wall surface), or rockwool or slag mineral wool batts weighing not less than 3.3 pounds per cubic foot (1 pound per square foot of wall surface).	15

C-101.6.3 Design of fire-resistant exposed wood members.

C-101.6.3.1 The fire-resistance rating, in minutes, of timber beams and columns with a minimum nominal dimension of 6 inches is equal to:

- Beams: (1) $2.54Zb [4 - 2(b/d)]$ for beams that may be exposed to fire on four sides.
(2) $2.54Zb [4 - (b/d)]$ for beams that may be exposed to fire on three sides.
Columns: (3) $2.54Zd [3 - (d/b)]$ for columns that may be exposed to fire on four sides.
(4) $2.54Zd [3 - (d/2b)]$ for columns that may be exposed to fire on three sides.

Where:

- b = The breadth (width) of a beam or larger side of a column before exposure to fire, inches.
 d = The depth of a beam or smaller side of a column before exposure to fire, inches.

Z = Load factor, based on Figure C-101.6.3A.

C-101.6.3.2 Formula (4) applies only where the unexposed face represents the smaller side of the column. If a column is recessed into a wall, its full dimension shall be used for the purpose of these calculations.

C-101.6.3.3 Allowable loads on beams and columns are determined using design values given in *Design Values for Wood Construction*, a supplement to the ANSI/AF&PA *National Design Specification for Wood Construction*.

C-101.6.3.4 Where minimum 1-hour fire resistance is required, connectors and fasteners shall be protected from fire exposure by 1 1/2 inches of wood, or other approved covering or coating for a 1-hour rating. Typical details for commonly used fasteners and connectors are shown in AITC Technical Note No. 7.

C-101.6.3.5 Wood members are limited to dimensions of 6 inches nominal or greater. Glued-laminated timber beams utilize standard laminating combinations except that a core lamination is removed. The tension zone is moved inward and the equivalent of an extra nominal 2-inch-thick outer tension lamination is added.

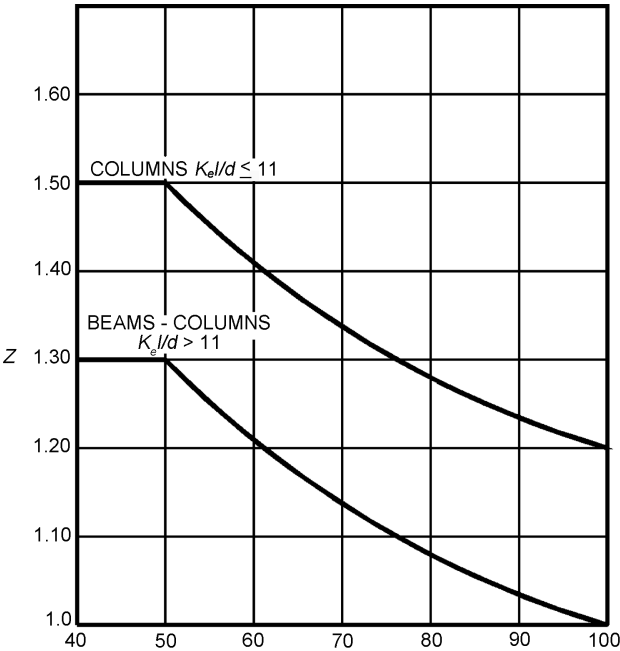


FIGURE C-101.6.3A
LOAD FACTOR

Notes:
 K_e = The effective length factor as noted in Figure C-101.6.3B.
 l = The unsupported length of columns, inches.

BLOCKING MODES						
THEORETICAL K_e VALUE	0.5	0.7	1.0	1.0	2.0	2.0
RECOMMENDED DESIGN K_e WHEN IDEAL CONDITIONS APPROXIMATED	0.65	0.80	1.2	1.0	2.10	2.4
END CONDITION CODE						
	ROTATION FIXED, TRANSLATION FIXED					
	ROTATION FIXED, TRANSLATION FIXED					
	ROTATION FIXED, TRANSLATION FREE					
	ROTATION FREE, TRANSLATION FREE					

FIGURE C-101.6.3B
EFFECTIVE LENGTH FACTORS

C-101.7 Other referenced documents. Refer to Subsection C-101.7.1, and NBS BMS 71, *NBS Fire Tests of Building Columns* and NBS TRBM-44 for fire-resistance ratings of materials and assemblies.

C-101.7.1 The following publications may be accepted as if herein listed:

FM Specification Tested Products Guide
GA Fire-Resistance Design Manual
SBCCI, ICBO, BOCA and ICC PST & ESI Evaluation Reports
UL Fire Directory

APPENDIX D

REGULATION OF SIGNS AND OUTDOOR ADVERTISING STRUCTURES

SECTION D-101 ADMINISTRATIVE REQUIREMENTS

D-101.1 Scope. The requirements of this Appendix shall apply to outdoor signs and display structures as classified in Subsection D-101.2, hereafter constructed, erected, installed, altered, repaired or maintained.

D-101.2 Classification. Classification of signs and outdoor display structures shall be as follows:

- (a) **Electric sign.** A sign containing electrical wiring, but not including signs illuminated by an exterior light source.
- (b) **Ground sign.** Sign supported directly on the ground by braces, uprights or poles with live and dead loads transmitted to the ground.
- (c) **Life safety sign.** Signs required for egress during an emergency in a building and other identification signs necessary for the safety of occupants.
- (d) **Marquee sign.** Sign attached to or hung from a marquee projecting from a building over public property.
- (e) **Projecting sign.** Sign affixed to building wall or structure projecting 12 inches or more beyond the building or structure, building line or property.
- (f) **Roof sign.** Sign constructed, erected or maintained on or above a roof or parapet wall of a building or structure.
- (g) **Sign structure.** Any structure which supports or is capable of supporting a sign as defined in this Code. A sign structure is permitted to be a single pole, multiple poles, archway or independent structure and is not required to be an integral part of the building.
- (h) **Temporary sign.** Sign constructed of nonpermanent materials for which a permit has been issued for a period of not more than 90 days.
- (i) **Wall sign.** Sign attached to, or erected against, the wall of a building or structure with exposed face of the sign in a plane parallel to the plane of said wall and projecting less than 12 inches from the building or structure, building line or property line.

D-101.3 Reserved.

D-101.4 Criteria.

- (a) Electrical signs shall be installed, operated and maintained in accordance with the requirements of the *EPCOT Electrical Code*, *UL 48 Standard for Electric Signs*, *UL 2161 Standard for Neon Transformers and Power Supplies* and this Appendix.
- (b) Signs shall not be erected, constructed or maintained so as to obstruct any fire escape or any window or door or opening used as a means of egress or so as to pre-

vent free passage from one part of a roof to any other part thereof. A sign shall not be attached in any form, shape or manner to a fire escape, nor be placed in such manner as to interfere with any opening required for ventilation.

- (c) A sign shall not be erected in a manner that would confuse or obstruct the view of, or interfere with, exit signs required by Chapter 8 or with official traffic signs, signals or devices. Signs and sign support structures, together with their supports, braces, guys and anchors, shall be kept in repair and in a proper state of preservation.

D-101.5 Permits.

- (a) Life safety signs require permitting.
- (b) Other signs and display structures hereafter constructed, erected, installed, altered, repaired or maintained shall require a permit.

Exception: The following signs are exempt from the requirements to obtain a permit when not subject to wind loads. In no case shall the installation of a sign violate other provisions of this Code.

- 1. Painted nonilluminated wall signs less than 40 square feet and not exceeding 35 pounds.
 - 2. Projecting signs not exceeding 2.5 square feet.
 - 3. Signs erected by transportation authorities.
 - 4. Pole mounted signs that do not exceed 4 square feet and are located in nonaccessible areas, protected by railing or landscape and that do not project into an occupied area.
- (c) Application for a permit shall be filed in accordance with the requirements of Chapter 3 and accompanied by drawings, computations, stress diagrams and other information regarding location, construction, weight, materials and electrical equipment as required by the Building Official. If filed by other than the owner of the property, the application shall bear the owner's signature. Drawings and computations shall bear the signature of a Professional Engineer registered in the State of Florida.
 - (d) Except for signs projecting over public property and roof signs, the Building Official may waive the requirement for drawings and computations when, in his opinion, public safety is not involved, and when the sign is less than 24 inches in either dimension.

D-101.6 Inspections.

- (a) Outdoor signs and advertising display structures requiring a permit shall be inspected by the Building Official, and the inspection shall be in accordance with the requirements of Chapter 3.

- (b) The permit holder shall request structural and electrical inspections of outdoor signs and advertising display structures before enclosing the wiring and shall request final inspection not more than 48 hours after the sign is completed.
- (c) Outdoor signs and advertising display structures shall be inspected at regular intervals as required by the Building Official. Removal of temporary signs shall be verified by the Building Official at the end of the time period specified in the permit.

D-101.7 Noncomplying signs. The owner, person, firm or corporation responsible for constructing, erecting or maintaining an outdoor sign or display structure that is unsafe or in any other way is in violation of this Code and Appendix shall be ordered by written notice from the Building Official to bring the sign into compliance with the requirements of this Code and Appendix. If within 10 days the order is not complied with, the Building Official shall cause the sign to be removed at the expense of the owner or lessee.

SECTION D-201 DESIGN AND CONSTRUCTION REQUIREMENTS

D-201.1 Design.

- (a) Wind pressure on signs shall be computed in accordance with the requirements of Chapter 9 and the design shall be based on panels remaining in place during winds of high velocity. Working stresses for materials shall conform to the requirements of Chapters 9 and 10. Bracing systems shall be designed and constructed to transmit stresses to the foundation. Dead and lateral loads of signs on or attached to buildings shall be transmitted through the structural frame of the building to the foundation without overstressing structural elements.
- (b) Members supporting unbraced signs shall be designed so the bearing loads imposed on the soil in either horizontal or vertical direction shall not exceed the values specified in Chapter 9. Brace ground signs shall be anchored to resist wind forces acting in any direction. Anchors and supports shall be designed for safe bearing loads on soil and for resistance to pull out 25 percent higher than the required resistance to over-turning.
- (c) The overturning moment produced from lateral forces shall not exceed two-thirds of the dead-resisting moment. Uplift caused by overturning shall be resisted by anchorage to the ground or to the structural frame of the building.
- (d) Vertical design loads shall be assumed to be acting simultaneously with wind loads.
- (e) Working stresses of guys, cables, rods and their fastenings shall not exceed 25 percent of the ultimate strength of the guy ropes and fastenings.

D-201.2 Construction.

- (a) Materials of construction for outdoor signs and advertising displays and their fastenings shall be of the quality and grade specified in Chapter 10 and in the requirements for special types of signs, Section D-301.

- (b) Display surfaces of all types of signs may be of metal, glass or approved plastic when used in accordance with the requirements of this Code. Maximum areas of glass panels shall be as specified in Section 1005. Plastic used shall conform to the requirements of Section 1008 and individual panels of approved plastic shall not be more than 120 square feet in area. The dimensional limitation of 120 square feet shall not apply to sign facing sections made from flame-resistant-coated fabric (ordinarily known as “flexible sign face plastic”) that weighs less than 20 ounces per square yard and that, when tested in accordance with NFPA 701, meets the fire propagation performance requirements of both Test 1 and Test 2 or that when tested in accordance with an approved test method, exhibits an average burn time of 2 seconds or less and a burning extent of 5.9 inches or less for 10 specimens.
- (c) Walkways and nonstructural trim on signs, including molding, battens, caps, nailing strips, lattices, cutouts or letters may be of wood, metal, approved plastics or a combination thereof.
- (d) Roof signs, wall signs, projecting signs and marquee signs shall be constructed of noncombustible material, except as provided in Paragraph (b) and Subsection D-301.1(a).
- (e) Anchors and supports when of wood embedded in the soil or within 6 inches of the soil shall be pressure impregnated as required in Section 1010.
- (f) Signs shall be secured to supports and supporting structures by rot-resistant fastenings. Wood or plastic plugs or pins shall not be used.
- (g) Outdoor signs and advertising displays shall be constructed with rainwater drains.
- (h) Electrolysis shall be considered in the design and prevented. The methods shall be shown on the drawings.

D-201.3 Clearances and location.

- (a) Signs projecting from a building or extending over public property shall maintain a clear height of 9 feet above the sidewalk and shall not extend to within 18 inches of the curb line.
- (b) Outdoor signs and advertising displays shall not obstruct an exit or a window used as a means of egress, or an opening required for ventilation, nor interfere with use of standpipes by the Fire Department, nor with passage from one roof to another by fire fighters.
- (c) Outdoor signs and advertising displays shall not be located within 6 feet horizontally or 12 feet vertically of overhead conductors carrying more than 750 volts.
- (d) Outdoor signs and advertising displays located within 5 feet of exterior walls required to be fire resistive by this Code shall be noncombustible throughout.
- (e) Outdoor signs and advertising displays shall not project into an alley below a height of 16 feet above grade, but may project 36 inches when located more than 16 feet above grade.

SECTION D-301 REQUIREMENTS FOR SPECIAL TYPES OF SIGNS

D-301.1 Electric signs.

- (a) Electric signs structure shall be of noncombustible material. Wood or approved plastic may be used for surface decoration if located at least 2 inches from the nearest current-carrying part of the sign.
- (b) Electric signs shall not display flashing red lights, nor use the words "Stop," "Go" or "Danger," nor shall an electric sign be an imitation of an official traffic signal or road sign.
- (c) The sign body and/or fabricated enclosure of an electric sign, intended for installation in a damp or wet location, shall be provided with drain openings in accordance with UL 48.
- (d) Signs intended for installation in damp or wet locations need not comply with the drain opening requirements of (c) provided that they comply with either:
 1. The requirements for a Type 3R or better enclosure as defined in the UL 50 *Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations*, or
 2. The Rain Test, described in UL 879 *Standard for Electric Sign Components*, where there is no indication of water entering the units.
- (e) Electric signs are required to be listed/marked to include the manufacturer's name, trade name, trade-mark or identifier and include electrical ratings and wiring methods.
- (f) Each sign and outline lighting system, feeder circuit or branch circuit supplying a sign, outline lighting system, or skeleton tubing shall be controlled by an externally operable switch or circuit breaker that opens all ungrounded conductors and controls no other load.

D-301.2 Ground signs.

- (a) **Height restrictions.** The structural frame of ground signs shall not be erected of combustible materials to a height greater than 35 feet above the ground. Ground signs constructed entirely of noncombustible material shall not be erected to a height of greater than 100 feet above the ground. Greater heights are permitted where approved and located so as not to create a hazard or danger to the public.
- (b) Ground signs shall be constructed of materials, resistant to deterioration from rot, termites and borers. Wood used below the ground shall be pressure impregnated as required in Section 1010. Steel used below grade shall be encased in concrete or all elements below grade shall be stainless steel. Aluminum used below grade or fastened to a concrete foundation shall have a barrier coating of epoxy or an approved equal to prevent aluminum-concrete chemical reaction.
- (c) Ground signs shall be erected so that the face of the sign paralleled to or at an angle not more than 30 degrees with the lot line shall be not less than 3 feet from the line. The ends of a sign at an angle of 30

degrees or more with adjacent lot lines may be extended to the lot line.

- (d) Lighting reflectors may project beyond the face of the sign.

- (e) Ground signs shall not project over public property.

D-301.3 Marquee signs. Marquee signs shall be noncombustible throughout and shall be at least 8 feet above the sidewalk or ground level. Marquee signs may be attached to the sides or front of a marquee for its entire length and width, but shall not extend outside the line of the marquee, nor more than 6 feet above or 1 foot below the marquee.

D-301.4 Projecting signs.

- (a) Signs projecting more than 12 inches from the building shall be constructed of noncombustible materials and shall be attached to the building or structure by metal bolts, anchors, supports, chains, guys or rods. Staples and nails shall not be used.
- (b) Dead and wind loads shall be supported by chains, guys or rods not less than $\frac{3}{8}$ inch in diameter at an angle of 45 degrees with the horizontal to resist the dead load, and at an angle of 45 degrees or more with the face of the sign to resist the wind pressure. When the area of the face of the sign exceeds 30 square feet, two supports shall be provided on each side not more than 8 feet apart to resist the wind pressure.

Exception: Signs that have been engineered to consider resisting wind and dead loads.

- (c) Supports of projecting signs shall be secured to a bolt or expansion screw that will develop the strength of the supporting chains, guys or steel rods with a minimum $\frac{5}{8}$ -inch bolt or lag screw. Turnbuckles shall be placed in chains, guys or steel rods that support projecting signs.
- (d) Chains, cables, guys or rods used to support live and dead loads of projecting signs may be fastened to solid masonry walls with expansion bolts or with machine screws in iron supports, but supports shall not be attached to a parapet wall. Where supports are fastened to walls of wood, anchor bolts shall pierce the wall and shall be secured on the inside.
- (e) Projecting signs shall not project above the roof or cornice wall above the roof level, except that signs installed at right angle to the wall and not over 18 inches in horizontal width may project 2 feet above the roof. A sign projecting from the corner of a building parallel to the vertical line or the corner shall be considered to be at a right angle to the building.

D-301.5 Roof signs.

- (a) Roof signs shall be designed in accordance with the requirements of Chapter 9. Loads shall be distributed to the structural frames and to the foundation without overstressing the structural members.
- (b) Roof sign structures shall be constructed of noncombustible materials throughout, except as specified in Subsection D-201.2(b).

- (c) Roof signs shall be constructed to leave a clear space of not less than 1 foot clearance between the roof level and the lowest part of the sign.

Exception: The bottom of the sign can be set at 2 inches above the roof line for removable signs that do not exceed 40 square feet and are mechanically fastened to the vertical supports that allow the sign body to be easily removed, leaving the vertical supports with not less than 12 inches clear above the roof line.

Signs larger than 40 square feet may have an escutcheon that is mechanically fastened to the sign structure, leaving not less than 2 inches between the bottom of the escutcheon and the roof line. The escutcheon is to be constructed to be easily removed for future roof repairs.

- (d) No part of a roof sign or structure shall project beyond the exterior walls of the building.
- (e) Roof signs more than 40 square feet in area shall be supported by steel, aluminum or concrete, fire protected when required for the type of construction.
- (f) Roof signs having a solid surface shall be not more than 24 feet above the roof level.
- (g) Open roof signs in which the open area is at least 40 percent of the total area of the sign may not exceed 75 feet above the surface of the roof or buildings of Types I and II construction and 40 feet above the surface of the roof for buildings of other types of construction. Anchorage to the roof of the building shall be by metal bolts, supports, chains, stranded cables, steel rods or braces.
- (h) Passage 3 feet wide shall be provided at parapet and roof level around all roof signs.

D-301.6 Wall signs.

- (a) Wall signs shall extend not more than 12 inches from the building to which they are attached.
- (b) Wall signs attached to exterior walls of solid masonry, concrete or stone shall be attached by metal anchors, bolts or expansion screws not less than $\frac{3}{8}$ -inch diameter embedded at least 5 inches.

Exception: Signs that have been engineered to consider resisting dead and wind loads.

- (c) Wall signs shall not be supported by anchorage to an unbraced wall.
- (d) Temporary wall signs of cloth in combustible frames shall be permitted for not more than 30 days and such temporary signs shall be not more than 100 square feet in area.
- (e) Wall signs which have an area exceeding 40 square feet shall be constructed of metal or other approved noncombustible material, except for nailing rails and as provided for in Subsection D-201.2(b).

APPENDIX E

REGULATION OF PRIVATE SWIMMING POOLS

SECTION E-101 ADMINISTRATIVE REQUIREMENTS

E-101.1 Scope. The requirements of this Appendix shall apply to private swimming pools as defined in the Rules and Regulations of the State of Florida pertaining to the Department of Health Rule 64E-9 F.A.C. and Chapter 514 F.S., except that wading pools shall be defined as having a maximum depth of 18 inches.

E-101.2 Criteria.

- (a) Design of swimming pools shall be in accordance with the requirements of Chapters 9 and 10, and this Appendix.
- (b) Materials used in the construction of swimming pools shall be concrete or other materials impervious to water, and such materials shall comply with the requirements of Chapter 10.
- (c) Construction and operation of swimming pools shall comply with the Rules and Regulations of the State of Florida referred to in 64E-9, F.A.C. and Chapter 514 F.S. Where there is conflict between the State of Florida regulations and those of this Code, the most restrictive requirement shall apply.
- (d) Installation of electrical equipment for swimming pools shall comply with the *EPCOT Electrical Code*.
- (e) Installation of heating and ventilating equipment shall comply with the requirements of the *EPCOT Mechanical Code* and the applicable requirements of the *EPCOT Fuel Gas Code*.
- (f) Installation of sanitary facilities and plumbing installations shall comply with the *EPCOT Plumbing Code* and the Rules and Regulations of the Florida State Board of Health.

E-101.3 Permits and inspections.

- (a) Application for permit to construct, alter or repair a swimming pool, or to install electrical and plumbing equipment therein, shall be filed in accordance with the requirements of Chapter 3. Separate permits shall be filed for building, plumbing and electrical installations. Permits for such construction shall be issued when the installation has been approved by the Building Official and the Florida State Board of Health.
- (b) Plans shall be drawn by a Professional Engineer registered by the State of Florida for the following:
 - 1. Pools requiring special design because of unstable soil or unusual ground water conditions.
- (c) Inspection of swimming pools shall be made in accordance with the requirements of Chapter 3. No swimming pool shall be placed in operation until it has been approved by the Florida State Board of Health.

SECTION E-201 CONSTRUCTION REQUIREMENTS

E-201.1 Design and materials. Materials of construction shall be as specified in the Rules and Regulations of the Florida State Board of Health and in the following requirements:

- (a) **Concrete.** Concrete used in construction of swimming pools shall be Portland cement reinforced concrete having a compressive strength of 2,500 pounds per square inch (psi) at 28 days. Reinforcing bars shall have not less than 3 inches of concrete protection when placed in contact with the soil.
- (b) **Masonry.** Unit masonry walls shall be two-cell blocks, laid with nominal 8-inch thickness in the wall. All voids shall be filled with concrete having a minimum strength of 2,500 psi at 28 days and shall contain aggregate no larger than will pass a No. 3 sieve. Filling of voids shall proceed in stages not to exceed 24 inches high or 12 times the least dimension of the void, whichever is greater. Concrete shall be thoroughly rodded into the voids. Walls more than 3 feet, 4 inches high shall have minimum vertical reinforcement of No. 3 bars placed 16 inches on center.
- (c) **Pneumatically placed concrete.** Pneumatically placed concrete shall be as specified in ACI 318, except that walls of swimming pools shall have a minimum thickness of 6 inches at the bottom and 4 inches at the top with the reinforcing centered.
- (d) **Other materials.** Other materials meeting the requirements of Chapter 9 for design strength may be used when tested in accordance with Section 311 and when approved as an alternative to the materials specified in Chapter 10.

E-201.2 Workmanship. Surrounding areas and walkways shall not drain into the pool. Completed pools shall pass a test for water tightness before being approved by the Building Official. A pressure relief valve or hydrostatic valve shall be provided to prevent uplift due to hydrostatic pressure when the pool is empty or is being drained.

APPENDIX F

REGULATION OF BUILDING CONSTRUCTION AND DEMOLITION OPERATIONS

SECTION F-101 ADMINISTRATIVE REQUIREMENTS

F-101.1 Purpose and scope.

- (a) The purpose of this Appendix is to provide regulations for attaining reasonable safety for life, limb and property during building construction and demolition, and the requirements herein are minimum for that purpose. The provisions of this Appendix are intended to supplement, but not to supersede, the requirements of this Code and the regulations of Florida Statute 442.
- (b) The provisions of this Appendix apply to all building and demolition operations and shall not be construed as replacing or conflicting with the provisions of Chapters 1 through 4.
- (c) In cases of practical difficulty or undue hardship in meeting the requirements of this Appendix, the Building Official may grant exceptions from the literal requirements or may permit the use of alternative methods or devices when reasonable safety is thereby assured.

F-101.2 Insurance and workmen's compensation. Before obtaining a permit for a building or demolition operation, the contractor shall provide proof of compliance with regulations of Florida Statute 440.

F-101.3 Sanitary facilities.

- (a) Temporary sanitary facilities shall be provided on sites of construction and demolition in accordance with the regulations of the Florida State Board of Health, Chapters 10D-6.08, 10D-6.09 and 10D-10.
- (b) Organic refuse, such as uneaten food from workers' lunches and food wrappings, shall not be permitted to accumulate on the site of a construction operation. Arrangements shall be made for regular collection of such refuse.

F-101.4 Protection of utilities. Substantial protective frame and boarding shall be built around and over every street lamp, utility box, fire or police alarm box, fire hydrant, catch basin and manhole that can be damaged by work being done and shall not obstruct the normal functioning of the device being protected.

F-101.5 Temporary light and power. All parts of a building under construction or being demolished, for which temporary lighting and power are required, shall be lighted in accordance with the requirements of the *EPCOT Electrical Code*.

F-101.6 Excavations. Safeguards shall be provided for excavations as required in Chapter 4 and the following provisions:

- (a) No more than one-half the width of the street or alley may be open or obstructed at one time.

- (b) Tunneling shall be permitted only in yards, courts and driveways of the building site. Approved underground installations shall not be damaged or removed.
- (c) When an excavation is made in a paved street requiring removal of paving, the permittee shall file a notice with the Department of Public Works that the excavation has been filled, tamped and made ready for repaving.
- (d) All parts of the street excavated shall be left in as good condition as before the excavation was made.
- (e) The trench or excavation shall be filled, rammed and puddled within 48 hours after making the connections or the repairs.
- (f) Barricades shall be provided and shall encircle the excavation or trench.
- (g) Signs shall be posted on the barricades stating the name of the permittee making the excavation.
- (h) Red flags shall be placed at intervals of 100 feet to warn the public of the existence of the excavation.
- (i) Red lights shall be placed at intervals of 100 feet during hours of darkness.

F-101.7 Temporary construction and use of equipment.

- (a) Except as set forth in this Code and Appendix, temporary construction and use of equipment on construction operations shall be in accordance with EPCOT Standard 5-1 and the pertinent requirements of the *EPCOT Electrical Code*.
- (b) All persons engaged in construction work or entering the site of a construction project shall be required to wear protective head gear.

F-101.8 Sandblasting, steam-cleaning, etc. In exterior operations, sandblasting, steam-cleaning, spray painting, water-proofing or other exterior operations shall be performed with sidewalk canopies in such a manner as not to create a nuisance and to adequately protect persons and property.

F-101.9 Exits. Where a building has been constructed to a height greater than one story, at least one lighted stairway shall be provided that meets the requirements of Section 806. The stairway shall follow the progression of the building construction.

Exception: When approved by the Building Official, a temporary, lighted stairway may be installed, until a permanent lighted stairway is available for use.

F-101.9.1 During demolition the stairway shall remain accessible, clear of obstructions, lighted and follow the building down during the demolition process. The stairway shall be protected from falling debris.

F-101.10 Construction fencing.

- (a) Construction fencing is required to have an approved building permit issued prior to installation.

Exception: Construction fences not greater than 4 feet high.

- (b) Construction fences located within or adjacent to fire lanes must be approved by the Fire Marshal.
- (c) Construction fences located more than 10 feet from guest or cast access routes may be designed to comply with Subsection 904.2(e).
- (d) Construction fences over 4 feet high and not greater than 8 feet high shall be installed to meet the minimum requirements of Figure F-1.
- (e) Construction fences greater than 8 feet high shall be required to be designed and installed to comply with the full wind load requirements of this Code.

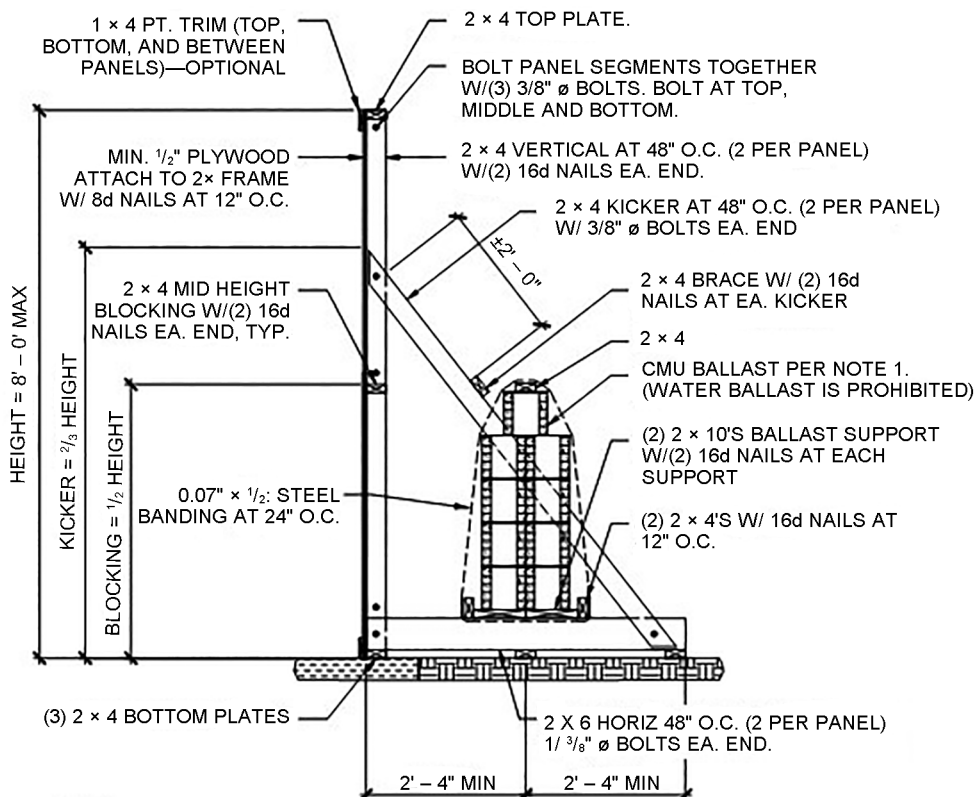
**SECTION F-201
ALLOWABLE USE OF PUBLIC
PROPERTY DURING CONSTRUCTION**

F-201.1 General. The amount of space and conditions under which use of public property is permitted for construction or demolition purposes shall be as set forth in Subsection F-201.2.

F-201.2 Limitations. Street or sidewalk space shall be permitted to be used if approved by the applicable governing authority and provided the following provisions are met:

- (a) A walkway shall be constructed in the outer portion of the permissible occupied street space, conforming to the requirements of Subsection F-201.4.
- (b) Building materials, fences, sheds or any obstruction of any kind shall not be placed so as to obstruct free approach to any fire hydrant, lamp post, manhole, fire alarm box or catch basin, or so as to interfere with the passage of water in the gutter. Protection against damage shall be provided to such utility fixtures during the

TYPICAL CONSTRUCTION BARRIER (4'-0" WIDE PANEL SEGMENTS)



NOTES:

1. PROVIDE (27) CMU BLOCKS OR 945 LB FOR BARRIERS 6' - 1" TO 8' - 0" TALL
PROVIDE (18) CMU BLOCKS OR 630 LB FOR BARRIERS 4' - 1" TO 4' - 0" TALL.
2. ALL $\frac{3}{8}$ " \varnothing BOLTS SHALL BE SAE GRADE 5 FOR BETTER CARRIAGE BOLTS WITH STANDARD WASHERS AND HEX HEAD NUTS. WING NUTS SHALL NOT BE USED.
3. DESIGN WIND SPEED = 103 MPH (ULTIMATE) / 80 MPH (SERVICE).

FIGURE F-1

progress of the work, but sight of them shall not be obstructed.

- (c) A 10-foot clear roadway shall be maintained through any alley located along the building site.
- (d) Proper precautions shall be made during construction to prevent concrete, mortar washings or any other material from entering a sewer.
- (e) The person or persons to whom a permit is issued for such purposes as stated herein, shall post with the applicable governing authority a bond of such type and amount as may be deemed advisable by the applicable governing authority as protection from any and all liability.

Exception: The provisions in this Subsection may be modified if approved by the applicable governing authority, provided alternative provisions are made to protect the public.

F-201.3 Where covered walkways are required.

F-201.3.1 Erection or demolition. During the erection or demolition of any building exceeding one story in height that is located at a distance less than 10 feet or less than one-quarter of the height of the building from any street or alley property line, or when required by the Building Official, a roof covering for the entire length of the project shall be provided over the temporary or permanent sidewalk, from the time the construction or demolition extends above the second-floor level until materials are no longer being used or handled on the front above such walk.

F-201.3.2 Exterior alterations or repair. Buildings having their exteriors altered or repaired in an extensive manner involving any hazard shall be provided with a covered walk as required for new structures during erection.

Exception: Where, in the opinion of the Building Official, a covered walk is not necessary, a permit may be issued to block off part of the sidewalk and have a temporary walk constructed as provided in Subsection F-201.4.

F-201.4 Construction of walkways, fences and protective coverings.

F-201.4.1 General. When required by the Building Official, before any construction work is commenced, the owner or his agent shall construct a temporary walkway in conformity to this Section.

F-201.4.2 Visual obstruction. All fences, barriers or temporary structures of any kind located on public highways shall be so constructed as not to obstruct vision at the intersection of streets.

F-201.4.3 Width. Walkways shall be not less than 4 feet wide in the clear except that in congested districts the Building Official may require a walkway as wide as, in his opinion, is necessary. Walks shall be built in a safe and substantial manner and be maintained in that condition at all times.

F-201.4.4 Handrail. A smooth handrail of substantial construction, not less than 3 feet high, shall be provided on the traffic or street side of the walkway, and also on the

building side when considered necessary by the Building Official.

F-201.4.5 Separation. Where the distance from building to street or alley property line is less than half the height of the building, a fence of substantially solid construction at least 8 feet high shall be provided on the building side of the walkway.

F-201.4.6 Roof. Roof coverings over walkways, as required by Subsection F-201.3, shall be considered of not less than one layer of 2-inch nominal dimension wood plank spanning not more than 3 feet between supports or equivalent decking. The framework supporting the walkway covering shall be well-braced and designed to support at least 150 pounds per square feet (psf), but the top deck shall be designed to carry not less than 250 psf. The roof covering shall be of width sufficient to cover the entire walkway or sidewalk, and shall be made water tight. Suitable provisions shall be made for adequate lighting of the walk under the covering, at all times. A minimum clearance of 8 feet, 6 inches shall be maintained above walkways.

F-201.5 Walkways over excavated areas. When the area occupied by the sidewalk or temporary walkways is to be excavated, such walk shall be made of boards not less than 2 inches nominal dimension designed to support a load of not less than 150 psf and meet the requirements of the *EPCOT Accessibility Code for Building Construction*. Such walkways shall be provided with a fence and handrails on each side.

F-201.6 Lights required. Every walkway shall be kept well-lighted continuously between sunset and sunrise, and the outer edge of the occupied space of the street or sidewalk shall have placed thereon lights, which shall burn continuously between sunset and sunrise.

SECTION F-301 FIRE PREVENTION

F-301.1 Welding. Fire protection measures taken during welding and torch operations shall conform to the requirements of EPCOT Standard 1009-5.

F-301.2 Open fires.

- (a) Disposal of waste materials from building and demolition shall be in accordance with regulations of the governing body. Open fires are prohibited.
- (b) Heaters with enclosed flames shall be used for heating roofing compounds or other material.
- (c) When heaters with enclosed flames are in use, a workman shall be in attendance whose duty is to control the use of such equipment at all times.

F-301.3 Standpipes. In buildings of six or more stories, not less than one standpipe shall be installed for use of the Fire Department during construction of the building. Standpipes shall be installed when the construction has progressed not more than 50 feet above grade. Standpipes shall have Fire Department inlet connections at accessible locations and adjacent to stairways that are usable during construction. Standpipe systems shall be extended as construction pro-

gresses to within one floor of the highest point where secured decking or flooring has been constructed.

F-301.4 Fire-extinguishing systems. In every building operation where a toolhouse, storeroom or shed is used, or where a room or space is used for storage, dressing room or workshop, at least one approved portable extinguisher of a type appropriate for the hazard shall be provided and maintained in an accessible location for every 10,000 square feet of the building area. A suitable fire extinguisher or other means of fire prevention shall be ready for instant use in locations where welding or cutting is done, or where flammable liquids are stored.

F-301.5 Access to fire hydrants. During building operations, unobstructed access from the street to fire hydrants and to outside connections for standpipes, sprinklers or other fire-extinguishing equipment, whether permanent or temporary, shall be provided and maintained at all times. No material or construction equipment shall be placed within 10 feet of such hydrant or connection, nor between it and the center line of the street.

SECTION F-401 STORAGE OF MATERIALS AND EQUIPMENT

F-401.1 Storage on public property.

- (a) Material and equipment used in construction and demolition shall be stored in accordance with the regulations of the Department of Public Works, the State of Florida and this Appendix.
- (b) Material and equipment necessary for work to be done under a permit shall not be placed or stored on public property so as to obstruct free and convenient approach to and use of a fire hydrant, fire or police alarm box, utility box, catch basin, manhole, or to interfere with the free flow of water in a street or alley gutter.
- (c) Mixing, handling and storing of mortar, concrete or other material on public property shall be done in a manner that will not deface public property or create a nuisance.

F-401.2 Storage of combustible materials.

- (a) Storage of combustible material shall not be permitted under or near welding operations. (See Subsection F-301.1.)
- (b) In buildings of concrete construction, forms of combustible material shall be stripped from the concrete and removed from the premises as soon as possible. No part of the building shall be used for storage of combustible material until the concrete forms have been removed.
- (c) Storage of material under or on stairs or in stairways or adjacent to stair openings shall not be permitted.

SECTION F-501 DEMOLITION OPERATIONS

F-501.1 Unobstructed passageways.

- (a) Walkways and passageways shall be provided for the use of workmen, who shall be instructed to use them,

and all such walkways and passageways shall be adequately lighted and free from debris and other materials.

- (b) Protruding nails and fastenings in lumber shall be withdrawn, hammered in or bent over as soon as the lumber is removed from the structure being demolished, or all lumber from demolition operations shall be placed in piles for cleaning or disposal.
- (c) Lumber sizes, as used in this Appendix, shall refer to nominal stock sizes.

F-501.2 Standards of operation.

- (a) All persons engaged in demolition work, or entering the site of a demolition project, shall be required to wear protective headgear meeting the requirements for Type I or II, Class A or B as set forth in *Safety Code for Head, Eye and Respiratory Protection*, ANSI Z2.1.
- (b) Workmen using jackhammers or engaged in work that may cause flying chips or particles likely to damage the eyes shall be furnished with safety goggles, with strength-tested lenses conforming to the requirements for chippers goggles, as set forth in ANSI Z2.1.
- (c) Persons required to work in dusty areas shall be furnished with dust-filter-type respirators as set forth in ANSI Z2.1.
- (d) Blasting operations shall be performed in accordance with the requirements of the *EPCOT Fire Prevention Code*. (See Subsection F-501.10.)

F-501.3 Warning signs and lights.

- (a) Danger signs shall be conspicuously posted around the property being demolished and barricades shall be provided at doorways and thoroughfares giving access to the property. Barricades shall be in place at all times, except during the actual passage of men and equipment.
- (b) During hours of darkness, red or amber lights, or flares, shall be placed on or around all barricades.
- (c) When demolition is not in progress, the contractor shall provide a watchman or watchmen who shall prevent the public from entering the danger zone and who shall maintain danger signs, lights and barricades.

F-501.4 Preparatory measures.

- (a) If a structure to be demolished has been partially wrecked by fire, flood, explosion, wind or other causes, the walls shall be braced or shored in accordance with the requirements of EPCOT Standards 6-4 and 9-7.
- (b) Electric power, gas, water, steam and other services shall be disconnected, capped or otherwise controlled at the building line or curb before demolition work is started. In each case, the utility or service company concerned shall be notified in advance and its cooperation obtained. Utility boxes, police or fire alarm boxes, and fire hydrants shall be protected as required in Subsection F-101.4.
- (c) If the demolition work is to proceed on part of a structure only, while the undemolished part remains in use,

all utility services shall be disconnected from the part to be demolished. Electric power circuits, gas lines or other utility lines shall be inspected to make certain that all services have, in fact, been disconnected. Existing electric circuits, gas lines or other services in a structure or part of a structure to be demolished shall not be used for any purpose during demolition; except that fire control standpipes and hydrants shall be retained in service, free from material or debris, and available for Fire Department use as long as required.

- (d) Glass doors and windows, and other glass, shall be removed before other demolition work is started.
- (e) Floor openings and shafts shall be boarded over or enclosed with substantial guardrails, constructed in accordance with Section 501 and Florida Statute 442.

F-501.5 Ground-level protection.

- (a) Before demolition is started, every sidewalk or public thoroughfare adjacent to the site shall be either closed or barricaded, or protected as specified herein. Thoroughfares open to the public shall be kept clear and unobstructed at all times.
- (b) If the structure to be demolished is more than two stories or 25 feet high, measured from sidewalk or street level, and the horizontal distance from the inside of the sidewalk to the structure is 15 feet or less, a sidewalk shed or canopy shall be constructed over the entire length of the sidewalk adjacent to the structure, wide enough to accommodate pedestrian traffic without causing congestion. Sidewalk sheds and canopies shall be lighted by either natural or artificial means sufficient to ensure safety at all times. Sidewalk sheds shall be constructed in accordance with the following requirements:
 1. A roof or deck shall be constructed consisting of planking not less than 2 inches thick, closely laid and made water tight, and shall be designed to sustain a load of not less than 150 psf. A minimum of 7 feet clearance shall be maintained between the underside of the roof structure and the sidewalk.
 2. If the roof or deck is to be used for the storage of material, the design shall provide for additional load capacity to accommodate safely the planned storage and shall be approved by the Building Official. When used for storage, the outside edge and ends of the deck or roof shall be provided with a substantial enclosure at least 42 inches above the deck of the shed. Such enclosures may be vertical or inclined outward at an angle of approximately 45 degrees and shall consist of boards laid close together, secured to braced uprights or toe boards and galvanized wire netting formed of not less than 16 U.S. gage wire and 1½-inch mesh.
 3. Unless the top deck of the sidewalk shed is built solidly against the face of the structure to be demolished, the vertical face of the supports of the shed next to the building shall be solidly fenced throughout. This shall not prohibit construction and use of solid sliding or swinging

gates as may be necessary for the movement of workmen and materials.

- 4. Except for necessary supports to carry the roof or deck load, the side of the sidewalk shed opposite to or away from the building to be demolished shall be open.
- (c) When the horizontal distance from the inside of the sidewalk to the structure is more than 15 feet and less than 25 feet, a sidewalk shed or canopy may be constructed along the inside edge of the sidewalk or, if permission has been granted to close the sidewalk, a substantial fence shall be constructed along the inside edge of the roadway. Fences for protection of pedestrians shall be constructed at least 8 feet high and shall meet the requirements of Subsection F-201.4. Fences shall be constructed of wood or other suitable material and shall be built solid for the entire height and length, except that openings necessary for movement, or workmen or materials may be provided with solid sliding or swinging gates.
- (d) When the horizontal distance from the inside of the sidewalk to the structure is more than 25 feet, a shed, canopy or fence as described in Paragraphs (b) and (c) may be built or, in place of such shed, canopy or fence, a substantial railing shall be constructed on the inside of the sidewalk or roadway along the entire length of the demolition site and shall be provided with movable bars for access of workmen and movement of materials for the work.
- (e) Where workmen's entrances are required, they shall be protected by canopies extending from the face of the building to a point not less than 8 feet from it. Such overhead protection shall be at least 2 feet wider than the building entrance or opening, and the canopy shall be at least as strong as the sidewalk shed specified in Paragraph (b).
- (f) Sidewalk shed or fence openings provided for movement of workmen and materials shall be kept closed at all times, except during actual passage of workmen, materials and vehicles.

F-501.6 Removal of materials.

- (a) No material shall be dropped at any point lying outside the exterior walls of the building, except through fully enclosed chutes leading to an exterior container.
- (b) Chutes shall be provided for removal of material through floor openings, shafts or interior courts when the vertical drop exceeds 20 feet.
- (c) Material chutes that are at an angle of more than 45 degrees from the horizontal shall be enclosed on all sides, except for openings at or about floor level for receiving materials.
- (d) Material chutes at an angle of less than 45 degrees from the horizontal may be left open on the upper side.
- (e) No part of a chute shall be at an angle greater than 85 degrees from the horizontal for a length of more than 20 feet, unless substantial stops or baffles are installed

to prevent descending materials from attaining dangerous speeds.

- (f) Openings in enclosed chutes for receiving materials shall be not more than 48 inches high, measured along the wall of the chute. In all stories below the top, such openings shall be located and constructed in a manner to prevent material from being deflected out of the opening when passing from above. All openings below the top shall be provided with a substantial cover or door, which shall be kept closed when the opening is not in use.
- (g) Every enclosed chute shall be equipped with a substantial gate at or near the discharge end, and a workman shall be assigned to control the gate and the positioning and loading of trucks. The designated workman shall prevent anyone from passing under or near the discharge end of the chute.
- (h) Openings into chutes, or holes in floors through which debris is dumped, shall be protected by a substantial guardrail not less than 42 inches high.
- (i) Intermediate floor openings for passage of material shall be enclosed with barricades or a substantial guardrail shall be provided. The guardrail shall be not less than 42 inches high and shall be located not less than 6 feet from the opening. Barricades or guardrails shall not be removed until the story immediately above has been demolished down to the floor line and all debris cleared from that floor.
- (j) When cutting a hole in a floor for passage of material makes the floor unsafe, the floor shall be shored as required in EPCOT Standards 6-4 and 9-7.

F-501.7 Stairs and passageways.

- (a) Except for stairs, passageways and ladders for the use of workmen, access to the building being demolished shall be enclosed at all times.
- (b) Existing stairs and handrails shall be kept in place and in usable condition as long as practicable, and steps and landings shall be kept free of debris.

F-501.8 Hand-wrecking.

- (a) Hand-wrecking is defined for the purpose of this Appendix as a demolition procedure wherein workmen accomplish the demolition by the use of hand-held tools, such as hammers, pry bars, jackhammers, saws, welding and cutting equipment, wrenches and similar tools. In a hand-wrecking operation, heavy equipment, such as cranes, winches, tractors and trucks, shall be used solely to lower heavy components safely and to haul debris from the site.
- (b) Hand-wrecking procedures shall be used under the following conditions:
 - 1. When demolishing part of a building, the remainder of which is to continue in service, with or without modification.
 - 2. When a building to be demolished is in such close proximity to other structures, public thor-

oughfares or other occupied areas that other demolition procedures cannot be followed safely.

- 3. When the building to be demolished is of such height that other procedures would be impractical or unsafe.
- (c) Masonry wall sections or other masonry building components shall not be permitted to fall on the floors of the building in such masses as to exceed the safe carrying capacity of the floors.
- (d) No section of wall, the height of which is more than 22 times its thickness, shall be permitted to stand without lateral bracing, unless the wall is in good condition and was originally designed to stand to a greater height without lateral support.
- (e) Workmen shall not be permitted to work on top of a wall when weather conditions constitute a hazard.
- (f) Structural members or load-supporting members on any floor shall not be cut or removed until all stories above that floor have been demolished and removed.
- (g) Before demolishing interior or exterior walls within 10 feet of an opening in the floor immediately below, such opening shall be boarded over, unless all workmen are removed from the floors below the access to such floors is prevented.
- (h) In buildings of skeleton construction, the steel framing may be left in place during the demolition of masonry work. Where this is completed, steel beams, girders and other structural members shall be cleared of loose material as the masonry demolition work progresses downward.
- (i) At the completion of each day's work, walls of the building being demolished shall be left in stable condition and in no danger of being overturned.
- (j) During the demolition of exterior walls of a structure originally more than 50 feet high, the Building Official may require the construction of catch platforms along the exterior faces of such walls where necessary, to prevent injury to the public and men working below.
- (k) Such catch platforms shall be constructed and maintained not more than three stories below the story from which the exterior walls are being removed. When the demolition has progressed to within three stories of ground level, catch platforms will not be required. Design of catch platforms shall be as follows:
 - 1. Catch platforms shall consist of outriggers and planks not less than 5 feet wide, measured in a horizontal direction from the face of the structure. Planks shall be laid tight together without openings between them and the wall.
 - 2. Catch platforms may be constructed of material other than wood when the material does not lessen the security against falling material.
 - 3. Catch platforms shall be capable of sustaining a live load of not less than 125 psf.

4. Catch platforms shall be inclined so that the outer edge is at least 6 inches higher than the inner edge.
 5. Supports shall consist of outriggers of strength to support the planks and falling material, and shall be secured against turning and spaced not more than 10 feet apart.
 6. Each outrigger shall be supported against the building and in window openings, and shall be tied to the building. Planks supported by the outrigger shall be not less than 2 inches thick and the ends shall overlap each other for a distance of at least 1 foot over the supports. All planks shall be secured against displacement.
 7. The outer edge of each catch platform shall be provided with a substantial enclosure, constructed at an angle of approximately 45 degrees with the horizontal and having its outer edge not less than 48 inches from the platform, measured along the slope of the enclosure.
 8. The enclosure shall consist of galvanized wire mesh made of not less than 16 U.S. gage wire and 1½-inch mesh. The enclosure shall be secured to supports placed not more than 10 feet apart.
 9. There shall be no openings between the platform and the enclosure.
 10. Supports for the enclosure shall be not less than 2 inches by 6 inches in section, with the greater dimension at right angles to the enclosures.
- (l) Materials shall not be dumped on catch platforms, nor shall such platforms be used for the storage of materials.
 - (m) When workmen are engaged in removing floors consisting of masonry filling between floor beams or girders, planks not less than 2 inches by 10 inches wide shall be provided and used by workmen breaking down the masonry. The planks shall be placed and fastened to give the workmen firm support, should the masonry collapse unexpectedly.
 - (n) Demolition of a floor shall not be started until the floor surrounding the work area shall have been cleared of debris and unnecessary material for a distance of 20 feet.
 - (o) Workmen shall not be permitted to work in an area directly under a floor being demolished and such area shall be barricaded to prevent access.
 - (p) Walkways not less than 30 inches wide, formed of planks not less than 2 inches by 10 inches, shall be provided and shall be used by the workmen whenever necessary to enable the workmen to reach a work location without walking on exposed beams.
 - (q) Storage of waste material or debris on any floor or roof of the building or structure being demolished shall not be permitted to such an extent that the floor load specified in Section 902 is exceeded.
 - (r) Space for storage of waste material or debris may be created by removing flooring and floor beams to an elevation of 25 feet above ground level, when such removal does not endanger the stability of the structure.
 - (s) Dumping material from upper floors into the storage space shall be discontinued during periods when workmen are in the storage space.
 - (t) Walls shall not be subjected to lateral pressure from stored material or lateral impact from falling material.
 - (u) The storage space into which material is dumped shall be blocked off, except for openings necessary for removal of material and such openings shall be closed at all times when material is not being removed.
 - (v) Beams shall not be cut until precautions have been taken to prevent a loose beam from swinging freely and striking a workman, a piece of equipment or any part of the structure being demolished.
 - (w) All structural steel shall be lowered from the building by cable and shall not be permitted to drop.

F-501.9 Cable and ball wrecking. Where desired to demolish a building by cable and ball, whether applied to a single wall or to an entire building, the following conditions shall be met:

- (a) Cable and ball wrecking will be permitted in cases where the building is located a distance from a public thoroughfare and the adjoining property at least equal to 1½ times the height of the building.
- (b) A public thoroughfare may be closed and barricaded to prevent entry of pedestrians or vehicles during demolition operations, provided that the separation from adjoining property specified in Paragraph (a) is maintained, and that a permit is secured to close the street.
- (c) When a building to be demolished is too high to meet the requirements of Paragraphs (a) and (b), hand-wrecking procedures may be used to reduce the building height to meet these requirements. Such hand-wrecking operations shall be terminated and the partly demolished building shall be vacated before cable and ball wrecking operations are started.

F-501.10 Use of explosives. Explosives shall not be used in the demolition of a building without written approval of the Building Official, and when used, shall conform to the requirements of the *EPCOT Fire Prevention Code*.

APPENDIX G

REGULATIONS FOR CONSTRUCTION OF STAGES, ENCLOSED PLATFORMS, MOTION PICTURE PROJECTION ROOMS AND OPEN-AIR EVENT OR PERFORMANCE PLATFORMS

SECTION G-101 ADMINISTRATIVE

G-101.1 Scope.

- (a) Part 1 of this Appendix shall apply to the construction, alteration, repair and maintenance of stages and enclosed platforms in legitimate theaters hereafter erected.
- (b) Part 2 of this Appendix shall apply to the construction, alteration, repair and maintenance of motion picture projection rooms and open-air event or performance platforms hereafter erected or installed.

G-101.2 Criteria. The requirements of this Appendix shall supplement, but shall not supersede, the requirements of this Code. Where there is a conflict between the provisions of this Code and Appendix, the requirements of this Code shall apply.

G-101.3 Design. The design of theaters, theater stages, enclosed platforms and motion picture projection rooms shall comply with Chapter 9.

G-101.4 Construction and materials. The type of construction and materials of construction shall conform to the requirements of Chapters 6 and 10.

G-101.5 Exits. Theater exits, stage exits and exits from motion picture projection rooms shall be as specified in Chapter 8.

G-101.6 Fire protection. Fire protection of structural members shall be as specified in Chapter 6 and EPCOT Standard 6-1.

PART 1— REGULATIONS FOR CONSTRUCTION OF STAGES, ENCLOSED PLATFORMS AND PROSCENIUM CURTAINS

SECTION G-201 DESIGN, CONSTRUCTION AND FIRE PROTECTION OF STAGES

G-201.1 Stage floors. All parts of stage floors shall be of Type I construction, except the part of the stage extending from the proscenium opening to the back wall of the stage and 6 feet beyond the full width of the proscenium opening on each side, which may be constructed of steel or heavy timber covered with a wood floor of not less than 2-inch nominal thickness. No part of the combustible construction, except the floor finish, shall be carried through the proscenium opening. Openings through stage floors shall be equipped with tight-fitting doors of wood of not less than 2-inch nominal thickness.

G-201.2 Proscenium walls.

- (a) A stage (as defined in Chapter 2) shall be separated from the auditorium by a proscenium wall of not less than 2-hour fire-resistive construction. The proscenium wall shall extend not less than 5 feet above the roof over the proscenium opening. In addition to the main proscenium openings, proscenium walls may have one opening at the stage-floor level and one from the basement into the orchestra pit, either of which shall be not more than 25 square feet in area. All openings in the proscenium wall of a stage, other than the proscenium opening, shall be protected by an automatic-closing fire assembly having a 1½-hour fire-resistive rating. (See Subsection 715.4 for requirements for automatic fire-extinguishing systems.)
- (b) The proscenium opening, which shall be the main opening for viewing performances, shall be provided with an automatic-closing fire-resistive curtain as specified in Section G-301.

G-201.3 Gridirons, fly galleries and pinrail.

- (a) Gridirons and fly galleries shall be designed to support not less than 75 pounds per square foot (psf). Each loft block well shall be designed to support 250 pounds per lineal foot and the head block well shall be designed to support the aggregate weight of all the loft block wells served. The head block well shall be provided with an adequate strongback or lateral brace to offset torque. The main counterweight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load sufficient to accommodate the weight imposed by the total number of loft blocks in the gridiron. The sheave blocks shall be designed to accommodate the maximum load for the loft blocks or head blocks served, with a safety factor of five.
- (b) Gridirons, fly galleries and pinrails shall be constructed of noncombustible materials. Fire protection of steel and iron may be omitted. Gridirons and fly galleries shall be designed in accordance with Chapter 9 and shall be fire protected as required in EPCOT Standard 6-1.

G-201.4 Stage ventilators.

- (a) There shall be one or more ventilators constructed of metal or other noncombustible material near the center and above the highest part of a working stage. Such ventilation shall be installed in the stage roof and shall have a total ventilation area equal to at least 5 percent of the floor area within the working stage area. The entire equipment shall conform to the requirements specified in the *EPCOT Mechanical Code*.

- (b) Ventilators shall open by force of gravity or by spring action sufficient to overcome the effects of neglect, rust, dirt, frost, snow, or expansion by heat or warping of the framework.
- (c) Stage ventilators shall not be connected with ventilating or air-conditioning systems serving other parts of the building.
- (d) Glass used in ventilators shall be protected against falling on the stage. A wire screen used under the glass shall be so placed that, if clogged, it cannot reduce the required ventilating area or interfere with the operating mechanism or obstruct the distribution of water from the automatic fire-extinguishing system.
- (e) Ventilators, penthouses and supporting framework shall be designed in accordance with Chapter 9. Curbs on which the ventilator rests shall be constructed of noncombustible materials as required for the roof.
- (f) Each ventilator shall be arranged to open automatically after the outbreak of fire by the use of an approved automatic-closing device as defined in Chapter 7. The fusible link and operating cable shall hold each damper closed against a minimum 30-pound counterforce exerted on each damper through its entire arc of travel and for a minimum of 115°F. A manual control shall be provided.
- (g) Springs, when employed to activate ventilator dampers, shall be capable of maintaining full required tension indefinitely. Springs shall not be stressed more than 50 percent of their rated capacity and shall not be located directly in the airstream, nor exposed to the elements.
- (h) A fusible link shall be placed in the cable control system on the underside of the ventilator at or above the roof line, or as approved by the Building Official, and shall be located so as not to be affected by the operation of fire-extinguishing systems.
- (i) Remote, manual or electrical control shall provide for both opening and closing of the ventilator doors for periodic testing and shall be located at a point on the stage designated by the Building Official. When remote control of the stage ventilator is electrical, power failure shall not prevent operation of the ventilator when a fire starts.

G-201.5 Stage switchboard. A hood shall be provided over the full length of the stage switchboard to protect electrical equipment from water from the fire-extinguishing system.

G-201.6 Flame-retardant scenery and other materials. No combustible scenery, drops, props, decorations or other combustible materials shall be placed on any stage or enclosed platform unless they are treated with an effective fire-retardant solution and maintained in fire-retardant condition as approved by the Fire Department.

G-201.7 Gas service. Every gas service to the stage section of a building housing a Group A occupancy shall be operated from every other service to the building. Each building shall be provided with an approved, adequately marked gas shutoff

valve at a convenient and conspicuous location outside the building.

SECTION G-301 PROSCENIUM CURTAINS

G-301.1 General requirements. A proscenium fire safety curtain shall be constructed and installed as specified in this Section. Proscenium fire safety curtains, when required, shall be made of approved materials constructed and mounted so as to intercept hot gases, flames and smoke, and to prevent a glow from a severe fire on the stage from showing on the auditorium side within a period of 30 minutes. The closing of the curtain from the full open position shall be effected in less than 30 seconds, but the last 8 feet of travel shall require not less than 5 seconds.

G-301.2 Definitions.

- (a) **Braille proscenium fire safety curtain.** A curtain that folds up and stores in a very limited space above the proscenium opening.
- (b) **Frame proscenium fire safety curtain.** A curtain with a rigid frame that stores over the proscenium opening in one flat panel.
- (c) **Modified frame proscenium fire safety curtain.** A curtain made up of various components of the frame and straight-lift-style curtains that stores over the proscenium opening in one flat panel.
- (d) **Straight lift proscenium fire safety curtain.** A curtain that stores over the proscenium opening in one flat panel.

SECTION G-302 CURTAIN MATERIALS

G-302.1 Curtain materials. Curtain fabric shall be made of approved material or an approved water curtain complying with NFPA 13. Curtain material shall be listed or supporting data submitted to the Building Official for approval.

G-302.2 Activation. The curtain shall be activated by a rate-of-rise heat detection installed in accordance with NFPA 72, and by an auxiliary manual control.

G-302.3 Fire endurance test. A sample fabric curtain with a minimum of two vertical seams shall be subjected to the ASTM E119 procedure applicable to nonbearing walls and partitions for 30 minutes. The curtain shall overlap the furnace edges an appropriate amount to seal the top and sides, and have a bottom pocket weighted with a minimum of 4 pounds per linear foot. The unexposed surface of the curtain shall not glow, and flame or smoke shall not penetrate the curtain (only vapors escaping due to elevating temperatures meeting the requirements in Subsection G-303.5 are allowable). Unexposed surface temperature and hose stream test requirements are not applicable to this Section. Sample curtains of other materials shall be subjected to the same requirements as fabric curtains.

G-302.4 Smoke density test. When subjected to the ASTM E84 procedure, a curtain fabric or other material tested in the condition it is to be used (coated or noncoated, painted or unpainted), shall have a maximum smoke density of 25.

SECTION G-303 DESIGN AND CONSTRUCTION

The various style curtains detailed in this Section shall be acceptable for use in all installations, except those in new facilities where the proscenium opening exceeds 50 feet wide or 30 feet high. Only frame or modified frame-style curtains shall be used for these installations.

G-303.1 Basic construction. The curtain shall consist of continuous vertical fabric panels joined using minimum 1-inch wide overlap seams. These and all other functionally stitched areas on the curtain shall contain two rows of lock-stitch stitching, using thread conforming to the requirements of Section G-302.

G-303.2 Curtain size. The curtain shall overlap the opening a minimum of 18 inches on each side and 24 inches at the top.

G-303.3 Pipe battens/vertical side edge hems. All curtains except those without batten pockets and/or vertical side edge hems, shall have a minimum 6-inch-flat single-thick pockets and triple-thick side edge hems a minimum $\frac{1}{2}$ inch wider than guide brackets or metal hem reinforcement pieces, but not less than 4 inches wide. Should the fabric being used be an acceptable (nonwire-reinforced) fabric, or an acceptable wire-reinforced fabric weighing less than $\frac{2}{3}$ pounds per square yard in accordance with Subsections G-303.2 through G-303.5; batten pockets shall be double thick. Pockets and vertical side edge hems shall be sewn as required by this Section. Minimum $1\frac{1}{2}$ -inch inside diameter metal battens shall be placed in the top and bottom curtain pockets where the proscenium opening's height is 18 feet or less and width is 34 feet or less; minimum 2-inch inside diameter metal battens shall be used for openings more than 34 feet and 50 feet or less wide, or more than 18 feet and 30 feet or less high. Metal battens shall be Schedule 40 or 80 steel pipe, or other metallic tubing meeting the physical specifications of Schedule 40 steel pipe. All batten joints shall be reinforced with minimum 18-inch sections of said pipes or tubing internally, and riveted.

G-303.4 A minimum 3-inch-thick yield pad made with an outer covering of the curtain fabric and filled with fiberglass or other noncombustible materials shall be sewn beneath the bottom batten pocket with two rows of stitching on each side of the pocket, to force the bottom batten to compress the yield pad against the stage floor when the curtain is in its deployed position.

G-303.5 Curtain styles.

(a) **Straight-lift style.** The straight-lift-style curtain shall comply with Paragraphs 1 through 4 and the requirements of this Section.

1. **Side edge hem metal reinforcements.** Side edge hems shall be reinforced for their full height with 0.064-inch-thick (16 ga) plated or painted sheet metal $5\frac{1}{2}$ inches wide on both sides of both

vertical hems, or with plated or painted minimum 2-inch by $1\frac{1}{2}$ -inch by $\frac{1}{8}$ -inch-thick steel angle with 2-inch by $\frac{1}{8}$ -inch flat steel clamped on both edges for their full height. Either system shall be fastened to the hems with pairs of minimum $\frac{3}{16}$ -inch-plated tubular or solid steel rivets, or bolts on 6-inch vertical centers.

2. **Roller guides.** Curtains for proscenium openings 50 feet or less wide and 30 feet or less high, not meeting the requirements of Paragraph 3, shall use a roller guide/metal track side edge guide system, using guides on maximum 18-inch vertical centers with roller or ball bearing steel wheels, and minimum 0.064-inch-thick (16 ga) plated steel tracks installed rigidly in place so that roller guides will operate smoothly with a lateral load of 2 psf over entire area of curtain. Each guide shall be attached to the curtains metal stiffened edges by way of three or more minimum $\frac{3}{16}$ -inch-plated tubular or solid steel rivets, or bolts or a single minimum $\frac{3}{8}$ -inch-plated machine screw assembly. An equivalent attachment system shall be permitted to be used.

3. **Spool guides.** Curtains for proscenium openings 50 feet or less wide and 22 feet or less high shall use bronze alloy, oil-impregnated wood or other spool-type wire guides on maximum 18-inch vertical centers on metal stiffened edges, in a guide wire side edge system where the guide wires are galvanized minimum $\frac{1}{4}$ -inch diameter 7-by-19 aircraft cable or flexible independent wire rope core wire rope installed securely using minimum $\frac{3}{8}$ -inch-locked turnbuckles, thimbles and three forged wire rope clips or one swaged fitting at each end of each guide wire; or the roller guide system in Paragraph 2.

Exception: Curtains for proscenium openings less than 50 feet wide and less than 18 feet high shall not require metal stiffened edges if a spool-type guide wire side edge system is used.

4. **Upper smoke seal.** An approximate 3-inch-diameter upper smoke seal made of the curtain fabric and filled with fiberglass or other noncombustible materials shall be installed to make as smoke tight a seal as practical when the curtain is in its deployed position.

(b) **Braille style.** The braille-style curtain shall comply with Paragraphs (a)1 through (a)4, except as follows:

1. Curtain shall have minimum 5 percent fullness in the height.
2. Side edge guide system shall be as specified in Paragraph (a)3 without either edge reinforcing/stiffening system.
3. Lift lines as specified in Subsection G-304.3 shall operate through plated steel D-rings on a path reinforced with a layer of the curtain's fabric

with raw edges turned under or equivalent webbing.

4. Galvanized minimum $\frac{1}{4}$ -inch-diameter 7-by-19 aircraft cable or flexible independent wire rope core wire rope, sized using a minimum 8-to-1 safety factor, shall be used for the drive line, which connects the winch to the cable clew.
5. Instead of the smoke seal required in Paragraph (a)4, an attached fill piece smoke seal made of the curtain fabric shall span the gap between the curtain and the proscenium wall.

(c) **Frame style.** The frame-style curtain shall consist of a rigid steel or metallic alloy frame, with a frame thickness not less than $\frac{1}{120}$ of the width, and $\frac{1}{96}$ of the height of the proscenium opening, but in no case less than 4 inches thick, complete with interior steel or metallic alloy members, and a single-thick fabric panel battened to the audience (downstage) side of the frame. The assembly shall operate properly when subjected to a lateral load of 2 psf over the entire area of the curtain. Cable, block sizes and all operating equipment shall be sized to accommodate the assembly's size and weight with a minimum 8-to-1 safety factor.

1. The side edge guide system shall consist of vertical steel flat edges parallel to the face of the curtain with bronze bushings on both surfaces, traveling in grooves in the vertical steel smoke pockets on both sides of the proscenium opening or a steel wheel roller or ball bearing roller guide system sufficiently strong to properly handle the requirements of the system.
2. A separate square or semicircular yield pad made of the curtain fabric and filled with fiberglass or other noncombustible materials, approximately as thick as the depth of the frame, shall be attached beneath the frame and create a seal when curtain is in its deployed position.
3. An appropriate diameter upper smoke seal, as described in Paragraph (a)4, shall be installed to create as smoke tight a seal as practical when the curtain is in its deployed position.
4. The modified-frame-style curtain shall be any variation or combination of the frame and straight-lift-style curtains yielding as assembly that will operate properly when subjected to a lateral load of 2 psf over the entire area of the curtain. Cable, blocks and operating equipment shall be sized to accommodate the assembly's size and weight with a minimum 8-to-1 safety factor.

SECTION G-304 OPERATING EQUIPMENT

G-304.1 Smoke pockets. The curtain's vertical edges and guide system shall be contained in smoke pockets fabricated of minimum $\frac{1}{4}$ -inch-thick painted structural steel shapes and plates, using minimum $\frac{3}{8}$ -inch-diameter Grade 5 bolts on maximum 4-foot centers to attach plates to the steel shapes for

the entire height of the pockets, or to attach plates at the bottom of both smoke pockets for a minimum of 6 feet for all nonrigid edge curtains, and a minimum of 4 feet more than the opening's height for frame and other rigid edge style curtains. These smoke pockets shall extend vertically a minimum of 1 foot above the top of the raised curtain and be securely fastened to the side of the proscenium walkway from the audience with minimum $\frac{1}{2}$ -inch-diameter Grade 5 anchors or bolts in concrete on maximum 4-foot centers or minimum $\frac{3}{8}$ -inch-diameter Grade 5 anchors or bolts in concrete on maximum 2-foot centers. An anchoring system equivalent in strength on concrete or other surfaces shall be permitted to be used. These smoke pockets may vary in depth and width, depending on the style of curtain and the distance the smoke pockets are set back from the vertical edges. Straight-lift curtains shall have minimum 6-inch-deep pockets, braille curtains shall have minimum 8-inch-deep pockets, and frame and modified-frame curtains shall have pockets a minimum of 4 inches deeper than the thickest batten or frame member. The pockets shall be a minimum of 11 inches wide, set back a minimum of 6 inches away from center stage at the proscenium arch and contain at least 3 inches of the curtain's vertical edges.

G-304.2 Side edge guide system. The curtain's side edge guide system shall comply with Section G-303.

G-304.3 Lift lines.

- (a) Straight-lift and braille curtains for proscenium openings 50 feet or less wide and 30 feet or less high, shall have galvanized minimum $\frac{1}{4}$ -inch-diameter 7-by-19 aircraft cable or flexible independent wire rope core wire rope lift lines on maximum 10-foot centers with a maximum 3 feet between the outside lift lines and the curtain's side edges; curtains for openings exceeding 50 feet wide or 30 feet high shall use the same type lift lines sized to provide at least an 8-to-1 safety factor.
- (b) Frame and modified-frame curtains may require larger diameter lift lines to meet the requirements in Subsection G-303.5(c). Galvanized 7-by-19 aircraft cable or flexible independent wire rope core wire rope shall be used.

G-304.4 Winch lifting devices. Straight-lift-style curtains for openings 42 feet or less wide and 22 feet or less high, and all braille-style curtains, shall be permitted to operate using properly sized manual or electric winches with adjustable hydraulic speed governing circuitry. Models with handles shall have removable handles, with appropriate signs in English and other languages prevalent in the area, stating: DANGER! REMOVE HANDLE AFTER USE!

G-304.5 Lift line hardware. Curtain lift lines, shall pass through block sheaves in or under the gridiron, steel trusses or beams to the counterweight guides or winch clew and fasten to the appropriate batten or frame member using appropriate plated or painted steel or equivalent material clamps, deburred, with corners rounded. Clamps shall be attached using appropriately sized minimum $\frac{3}{8}$ -inch-diameter Grade 5 bolts, with each lift line attached using a thimble and one swaged fitting or three forged wire rope clips. Equivalent attachment methods that do not use clove hitches or leave exposed fabric cut edges shall be acceptable. Connections to

counterweight guides and winch drive line clews, shall be made using a thimble and one swaged-type fitting or three forged wire rope clips at each cable. Turnbuckles, when used, may be $\frac{1}{8}$ inch larger in diameter than the cable being used.

G-304.6 Stay chains. Straight lift and braille curtains for proscenium openings 50 feet or less wide and 30 feet or less high shall have safety stay chains of straight welded link minimum $\frac{1}{4}$ -inch-proof coil chain fastened securely to the curtain's top batten. Other curtains shall have the same safety stay chains sized to be sufficiently strong to safely support the curtain. There shall be one more chain than the number of lift lines, except for the chains at the ends of the curtain, and they shall be centered between the lift lines. One end of each chain shall be securely attached to the curtain's highest steel batten or frame member with the other fastened securely to steel brackets or other steel above the curtain in a manner that will safely support the curtain assembly. Chains shall be adjusted to support the curtain in its deployed position, and shall be permitted to be the method of holding a braille curtain's top batten in its stationary position. Except for wire rope clamps, swaged fittings and thimbles, attachments shall meet the requirements in Subsection G-304.5.

G-304.7 Head and loft blocks. Precision ball or tapered roller bearing blocks with grooves machined to cradle and protect the cables shall be supported on the proscenium wall by appropriate steel brackets, structural steel beams, trusses or other steel that may be added. Loft blocks using $\frac{1}{4}$ -inch-diameter cable shall be minimum 8-inch diameter for proscenium openings 20 feet high or less and minimum 12-inch diameter for all others. Larger cable sizes shall require loft blocks with diameters a minimum of 38 times the cable diameter. Head blocks shall be at least 4 inches larger in diameter than the loft blocks. Blocks shall be installed so as to prevent cable fouling and have appropriate capacities.

G-304.8 Controls. The mechanism and devices for operating the curtain shall be of simple design and positive in operation. Nonautomatic operation of curtains installed on proscenium openings of 1,500 square feet or less, may be by manual means, as long as operation can be accomplished with relative ease by a single person. Nonautomatic-operation curtains shall be by electric devices.

G-304.9 Emergency release.

- (a) **Automatic.** Automatic emergency curtain deployment shall be by gravity. A minimum $\frac{3}{8}$ -inch-diameter manila rope, or minimum $\frac{3}{32}$ -inch-diameter 7-by-19 galvanized aircraft cable emergency control line shall extend up both sides and above the proscenium opening. It shall contain a minimum of four maximum 165°F, nonelectric fusible links, one on each side of the opening and two overhead. When any link in the series separates, the curtain shall automatically properly deploy. The fire curtain's automatic emergency release system shall not be connected with the building's fire alarm system; it shall also not be connected to the emergency ventilator release system, unless a time delay ensures the fire curtain will fully deploy before the vents open.

- (b) **Manual.** A pull pin or equivalent manual activation assembly shall be located on both sides of the proscenium opening. Manual emergency curtain deployment shall be accomplished by the activation of either assembly, both of which are incorporated into the emergency control line, and attached to the counterweight arbor or wench by a mechanical quick-release mechanism, unless the emergency control line rigging is accomplished in a manner that does not require this quick-release assembly. Knife, axe and other emergency-release line cutting systems, and ball/fly away knot quick-release systems, shall only be permitted in existing installations until a new fire curtain is installed. The emergency control line shall be constructed such that the curtain can be easily reset to its ready position within a few minutes in the case of an erroneous activation, manually or automatically.

G-304.10 Signs. Appropriate signs in English and other languages prevalent to the facility's area shall be prominently displayed at the locations of the emergency control line's emergency manual activation assemblies. For pull pin assemblies with rings attached, the signs shall read: IN CASE OF FIRE, PULL RING FOR EMERGENCY LOWERING OF FIRE CURTAIN! There shall also be a less prominent sign or instruction pamphlet in English located on the main control side of the opening, detailing the procedure required to properly and quickly reset the fire curtain to its ready position.

G-304.11 Electric operation. Electric operation shall be from a single station located on either side of the proscenium opening, and shall consist of two "Hold-To-Operate-Style" push buttons, one labeled "Up" and one labeled "Down." Alternately, three push buttons that function from a single push of a button shall be used; one button labeled "UP," and one labeled "DOWN," and one labeled "STOP." A sign stating: NONEMERGENCY FIRE CURTAIN OPERATION shall be adjacent to the push button station.

G-304.12 Manual operation. Curtains with endless operation handlines shall consist of $\frac{3}{4}$ -inch manila rope securely fastened to both the top and bottom of the counterweight arbor or spliced to itself in certain applications, and pass under a minimum 12-inch-diameter floor block, which is adjustable for tension.

G-304.13 Counterweights. The top and bottom counterweight sections of the arbor shall be of steel, sufficiently heavy to safely accommodate the loads. The top and bottom sections shall be connected with rods not less than $\frac{3}{4}$ inch in diameter, with one tie plate for every 4 feet of rod. Counterweights may be cast iron or flame cut steel, with edges deburred. There shall be smooth grooves on the ends of the weights, which engage the steel rods. The arbor top and bottom shall be provided with bronze or other nonflammable guides.

G-304.14 Counterweight guides. Counterweight guide tracks shall be structural tees or angles properly tied together and securely anchored to a wall. All joints where the counterweight travels shall be ground smooth. These guide tracks shall be engaged their entire length.

G-304.15 Adjustable curtain closure speed system. Curtains shall have an approved adjustable checking device or system, whether it be a counterweight arrangement, a hydraulic speed governing system, a hydraulic dash pot shock absorbing unit, or another equivalent device or system, enabling the installation to meet the automatic-closing requirements in Subsection G-301.1.

SECTION G-305 NEW DESIGNS

G-305.1 Curtain materials. Curtain materials shall meet the requirements of Subsections G-302.1 through G-302.4. Curtains made of materials other than fabrics shall not be required to be listed by an approved agency.

G-305.2 Curtain styles. Curtain styles that are combinations of, or modifications of, other styles specified in this Appendix shall be acceptable if the design meets the criteria of the modified-frame-style curtain. Other designs shall be acceptable if approved by the Building Official.

G-305.3 Water deluge systems. Water curtains or deluge systems with or without automatic-closing flame-resistant curtains shall not be permitted.

SECTION G-401 ENCLOSED PLATFORMS

G-401.1 Fire resistance. Walls and ceilings of an enclosed platform in an assembly room shall be of not less than 1-hour fire-resistive construction when more than 400 square feet in area.

G-401.2 Occupancy separation. In buildings having an enclosed platform, the dressing room section, workshops and storerooms shall be separated from each other and from other parts of the building by not less than a 1-hour fire-resistive occupancy separation as defined in Section 502, except that a chair-storage area under the platform and having headroom of not more than 4 feet need not be so separated.

G-401.3 Ventilation. Enclosed platforms shall be provided with one or more ventilators conforming to the requirements of EPCOT Standard 7-9 and Subsection 503.7, except that the total area shall be equal to not less than 5 percent of the area of the platform. When more than one ventilator is provided, they shall be spaced so as to provide satisfactory exhaust ventilation. Ventilators shall not be required for enclosed platforms having a floor area of 500 square feet or less.

PART 2— MOTION PICTURE PROJECTION ROOMS

SECTION G-501 GENERAL REQUIREMENTS

G-501.1 Scope. The provisions of this Subsection shall apply where ribbon-type cellulose acetate or other safety film is used in conjunction with electric arc, Xenon or other light-source projection equipment, which develops hazardous gases, dust or radiation.

G-501.2 Projection room required. Each motion picture machine projecting film within the scope of this Subsection shall be enclosed in a projection room. Appurtenant electrical equipment, such as rheostats, transformers and generators, may be within the projection room or in an adjacent room of equivalent construction. There shall be posted on the outside of every projection room door and in the projection room a conspicuous sign with 1-inch block letters stating: SAFETY FILM ONLY PERMITTED IN THIS ROOM.

SECTION G-601 CONSTRUCTION REQUIREMENTS

G-601.1 Construction. Every projection room shall be of permanent construction of the same type as the building in which the projection room is located. Openings need not be protected. The room shall have a floor area of not less than 80 square feet for a single machine, and at least 40 square feet for each additional machine. Each motion picture projector, floorlight, spotlight or similar piece of equipment shall have a clear working space not less than 30 inches by 30 inches on each side and at the rear thereof, but only one such space shall be required between two adjacent projectors. The projection room and rooms appurtenant thereto shall have a ceiling height of not less than 7 feet, 6 inches.

G-601.2 Projection ports and openings. The aggregate area of openings for projection equipment shall not exceed 25 percent of the area of the wall between the projection room and the auditorium. All openings shall be closed with glass or other approved material.

G-601.3 Ventilation. Ventilation shall be provided in motion picture projection rooms in accordance with the following requirements:

- (a) **Supply air.** Every projection room shall be provided with two or more separate fresh air inlet ducts with screened openings terminating within 12 inches of the floor and located at opposite ends of the room. Such air inlets shall be not less than 144 square inches in area and of sufficient size to permit an air change every 3 minutes. Fresh air may be supplied from the building's air-conditioning system, but when this is done, the system outlet shall be arranged so that the projection room will continue to receive one change of air every 3 minutes.
- (b) **Exhaust air.** Every projection room shall be provided with one or more air outlets that may be manifolded into a single duct outside the room. Exhaust outlets shall be so located as to ensure a circulation throughout the room. Such an exhaust air system shall be independent of any other air system. Exhaust air ducts shall terminate at the exterior of the building in a location such that the exhaust air cannot be recirculated into the supply air system. The exhaust shall be mechanically operated and of a capacity to provide a minimum of one change of air every 3 minutes. The blower motor shall be outside the duct system. The projecting room ventilation system may also serve appurtenant rooms, such as the generator room and the rewind room.

- (c) **Projection room ventilation.** Each projection machine shall be provided with an exhaust duct that will draw air from each lamp and exhaust it directly to the outside of the building so that the exhaust air will not be picked up by supply inlets. Such duct shall be of rigid materials, except that a continuous flexible connector approved for the purpose may be used. The lamp exhaust system shall not be interconnected with any other system.
- (d) **Electric arc equipment.** The exhaust capacity of electric arc projection equipment shall be 200 cubic feet per minute (cfm) for each lamp connected to the lamp exhaust system or shall be as recommended by the manufacturer of the equipment. Auxiliary air may be introduced into the system through a screened opening to stabilize the arc. Such an auxiliary air duct opening shall be screened.
- (e) **Xenon equipment.** The lamp exhaust system of Xenon projection equipment shall exhaust not less than 300 cfm per lamp, nor less than the exhaust volume required or recommended by the equipment manufacturer, whichever is greater. The temperature of the lamp housing shall not exceed 130°F when operating.

G-601.4 Miscellaneous equipment.

- (a) Every projection room shall be provided with rewind and film storage facilities.
- (b) Sanitary facilities shall be provided as required in the *EPCOT Plumbing Code*.
- (c) A maximum of four nonbreakable containers for flammable liquids, not greater than a 16-ounce capacity, may be permitted in every projection room.

**SECTION G-701
OPEN-AIR EVENT
OR PERFORMANCE PLATFORMS**

G-701.1 Performance or event platforms. Any platform or stage must meet the requirements of this Code and the *EPCOT Accessibility Code for Building Construction*. All performance or event platforms, as well as any associated light trusses, scaffold towers and electrical power, require permitting.

Exception: Performance or event platforms less than 30 inches in height do not require a building permit, unless accessible to the public.

G-701.2 Plans and specification requirements. An accurate and complete site plan, two sets of performance or event platform construction plans with framing and structural details shall be submitted. Structural calculations may be required depending on the complexity of the platform. The platform plans shall also show accessibility to conform with the *EPCOT Accessibility Code for Building Construction*. An event stage or performance platform 30 inches in height or greater shall have guardrails or edge protection.

APPENDIX H

REGULATION OF COMMERCIAL STABLES

SECTION H-101 ADMINISTRATIVE REQUIREMENTS

H-101.1 Scope. The requirements of this Appendix shall apply to stables and barns, and their appurtenances, hereafter constructed, erected, maintained, repaired or altered. Such buildings and structures shall be classified as Group S, Division 2, in accordance with Table 5.1 and Subsection 516.1.

H-101.2 Criteria.

- (a) Design of buildings and structures housing Group S-2 occupancies shall comply with the requirements of Chapter 9 for design loads and with the applicable requirements of Section 516, and Chapters 7 and 8.
- (b) Material used in construction of buildings and structures housing Group S-2 occupancies may be any material complying with the requirements of this Code and Appendix.

H-101.3 Location on property.

- (a) Buildings and structures housing Group S-2 occupancies shall be subject to the requirements of Chapter 7 for location on property and for fire protection of openings. Minimum spacing between barns on the same property shall be 50 feet.
- (b) Location of buildings classified as Group S-2 occupancies shall comply with the requirements of the Zoning Regulations.

H-101.4 Area and height.

- (a) Buildings or parts of buildings classified as Group S-2 occupancies shall not exceed the areas set forth in Table 7.5, but in no case shall the area of a barn be more than 12,000 square feet, except when a fire separation wall of 1-hour fire-resistive construction is provided with a parapet wall extending at least 2 feet above the roof. Where a fire separation wall crosses a walk-around area, the barn walls shall be 1-hour fire-resistive construction for a length of 5 feet in both directions from the wall. Ceilings of the walk-around area shall be finished on the underside as for 1-hour fire-resistive construction.
- (b) Buildings or parts of buildings housing Group S-2 occupancies shall be not more than 14 feet at the highest point.
- (c) Gas appliances used in buildings housing Group S-2 occupancies shall be installed in accordance with the *EPCOT Fuel Gas Code*, and shall be vented.

SECTION H-201 SPECIAL REQUIREMENTS

H-201.1 Automatic fire-extinguishing systems. Buildings or parts of buildings housing Group S-2 occupancies shall be provided with approved automatic fire-extinguishing systems throughout, including storage areas.

H-201.2 Use of materials.

- (a) Where metal construction is used, pressure-treated, fire-retardant wood liner shall be installed for stall walls, stall doors and other areas.
- (b) Where concrete block is used for construction of stalls, wooden kick boards shall be installed on all sides of the stall.
- (c) Roofing of barns shall be Class C, fire-retardant roofing, or better, as specified in EPCOT Standard 7-7.
- (d) Floors of stalls and tack rooms may be of any material approved for use by this Code.

H-201.3 Walk-around areas.

- (a) The minimum width of a walk-around area shall be 10 feet and the outer edge of the roof shall be at least 8 feet above the ground level.
- (b) Pitch of a roof of metal shall be not less than 3 inches in 12 inches and, when the roof is of composition shingles, the pitch shall be not less than 4 inches in 12 inches.
- (c) Walk-around areas shall be provided with electric lighting fixtures not less than 7 feet from the ground on the inside wall. The lights shall be covered with wire guards. Grounded electrical outlets shall be provided at a ratio of one for each two stalls. All electrical work shall be installed in accordance with the requirements of the *EPCOT Electrical Code*.
- (d) Water faucets shall be provided in walk-around areas at the ratio of one faucet for each five stalls, located either on the inner wall or in the outer perimeter of the walk-around area.
- (e) The outer edge of the walk-around area shall not be enclosed with fixed railing or other construction that would hinder evacuation of horses in the event of fire. Removable railings may be used.

H-201.4 Stalls.

- (a) Stalls shall be not less than 12 feet by 12 feet in dimension and shall be not higher than the minimum slope of the roof of the barn.
- (b) Stalls shall be tight, with pressure-treated, fire-retardant boards not less than 2-inch nominal dimension,

butted against each other as closely as possible to a height of not less than 7 feet. Above the height of 7 feet, nominal 1-inch pressure-treated, fire-retardant boards may be used and shall be carried flush to the ceiling.

- (c) Stall doors shall be a minimum of 4 feet wide and 9 feet high. The space above the door may be left open or screened with 1/4-inch noncorrosive wire mesh or a roof vent shall be installed along the ridge of the barn roof.
- (d) Sills for stall doors shall be at least 3 inches thick and 18 inches wide, and shall be of pressure-treated, fire-retardant wood or similar resilient, durable material. One edge of the sill shall be flush with the outside wall of the stall with the widest part of the sill extending into the stall.
- (e) Latch bolts or door-holding equipment shall be located so that halters cannot catch on them. Eye bolts for mounting webbing or cross bars shall be permanently installed on the face of the jamb.
- (f) No obstruction shall be permitted to interfere with the action of sprinkler heads in the stalls.
- (g) Electrical installations in stalls shall be permanent ceiling fixtures of a capacity to permit use of large wattage appliances for treatment of ailing horses, and shall comply with the requirements of the *EPCOT Electrical Code*.

H-201.5 Tack rooms.

- (a) Construction of tack rooms shall comply with the requirements for occupancies in Chapter 5 as to area, floor and wall finishes, ceiling height and exits. Heating and ventilating equipment shall comply with the requirements of the *EPCOT Mechanical Code* and sanitary facilities shall comply with the requirements of the *EPCOT Plumbing Code*.
- (b) Tack rooms shall be of 1-hour fire-resistive construction throughout.
- (c) Tack rooms shall be provided with grounded electrical receptacles installed in accordance with the *EPCOT Electrical Code*.
- (d) Doors and windows of tack rooms shall be screened.

H-201.6 Storage areas.

- (a) Feed shelters shall be constructed with one side open to the walk-around area and shall be detached from the barns by an opening at least 2 feet higher than the barn roof.
- (b) Floors of feed shelters shall be concrete slabs 6 inches thick.
- (c) Feed shall not be stored within 18 inches of fire sprinkler heads.
- (d) Feed shelters shall be provided with grounded electrical outlets, installed in accordance with the requirements of the *EPCOT Electrical Code*.
- (e) Storage of flammable liquids shall comply with the requirements of EPCOT Standards 5-4 and 5-5.

APPENDIX I

REGULATION OF COVERED WALKWAYS AND MALLS

SECTION I-101 ADMINISTRATIVE REQUIREMENTS

I-101.1 Purpose and scope. The purpose of this Appendix is to provide additional requirements to those contained in this Code for connections between buildings and structures, such as covered malls, covered walkways and tunnels located at, above or below grade level.

I-101.2 Definitions. The following definitions applying to this Appendix supplement the definitions contained in Chapter 2.

- (a) **Anchor building.** An exterior perimeter department store, major merchandising center or Group R-1 occupancy having direct access to a covered mall building, but having all required exits independent of the mall.
- (b) **Covered mall.** Covered or roofed interior area having a minimum horizontal dimension of 30 feet used as a pedestrian public way connecting buildings or a group of buildings housing individual or multiple tenants.
- (c) **Covered mall building.** A single building, enclosing a number of tenants and occupancies, such as retail stores, drinking and dining establishments, entertainment and amusement facilities, offices and other similar uses, wherein two or more tenants have a main entrance into the mall.
- (d) **Covered walkway.** Roofed, unobstructed walkway connecting buildings, used as a passageway for pedestrians, having a minimum horizontal dimension of 30 feet and where less than 50 percent of the perimeter is enclosed.
- (e) **Enclosed walkway.** Roofed, unobstructed walkway connecting buildings, used as a passageway for pedestrians having a minimum horizontal dimension of 30 feet, and where 50 percent or more of the perimeter of the walkway is enclosed.
- (f) **Kiosk.** Within a mall, shall not exceed 200 square feet.
- (g) **Mall.** A roofed or covered common pedestrian area within a covered mall building, which serves as access for two or more tenants and may have three levels that open to each other.
- (h) **Tunneled walkway.** Unobstructed underground walkway connecting buildings, used as a passageway for pedestrians.

SECTION I-201 CONSTRUCTION REQUIREMENTS

I-201.1 Covered malls.

- (a) Covered malls shall be of Type I or II construction as set forth in Table 7-5 for the applicable Group B occupancy. The area of covered malls may be tripled when the mall is provided with an approved automatic fire-extinguishing system, except that the unlimited areas

permitted in Subsection 712.3 shall not apply to covered mall.

- (b) The roof construction and supporting members of a covered mall shall comply with the requirements of Subsection 601.1(b) and Table 6.2 for the type of construction permitted for buildings connected by the mall, but shall be not less than 1 hour of heavy timber construction.
- (c) When permitted in a mall roof assembly, concealed spaces shall be separated from the adjoining buildings by not less than 1-hour fire-resistive construction.
- (d) Hose cabinets shall be provided for each 200 feet of mall length.

I-201.2 Covered walkways. A covered walkway may be of any type of construction permitted by this Code when the walls and openings at the point of connection of the walkway to the building are protected in accordance with the requirements of Chapter 7 to prevent spread of fire from one building to another. The covered walkway shall not contribute to the building area or the number of stories or height of connected buildings.

- (a) Covered walkways shall be not less than 10 feet in length and 44 inches in width. The total width shall not exceed 30 feet.
- (b) The length of exit access travel shall not exceed 300 feet.
- (c) Covered walkways over a public way shall also comply with Section 402.
- (d) See Section 401 for requirements for the protection of pedestrians during construction or demolition.

I-201.3 Enclosed walkways. An enclosed walkway shall be of the type of construction required for the buildings connected by the walkway. Separation between the enclosed walkway and the building to which it is connected, except when used as a required exit, shall be of not less than 2-hour fire-resistive construction. Openings in the walls of the building to which the enclosed walkway is connected shall be protected by an approved opening protective having a 1½-hour fire-resistive rating. The enclosed walkway shall not contribute to the building area or the number of stories or height of connected buildings.

- (a) Enclosed walkways shall be not less than 10 feet in length and 44 inches in width. The total width shall not exceed 30 feet.
- (b) The length of exit access travel shall not exceed 200 feet.
- (c) Enclosed walkways shall be mechanically or naturally ventilated.
- (d) Enclosed walkways over a public way shall also comply with Section 402.

I-201.4 Tunneled walkways. A tunneled walkway shall be of a type of noncombustible construction or construction approved by the Building Official for location underground. Separation between the tunneled walkway and the buildings to which it is connected shall be of not less than 2-hour fire-resistive construction. Openings in the walls shall be protected by an approved opening protective having a 1½-hour fire-resistive rating.

SECTION I-301 EXIT REQUIREMENTS

I-301.1 Covered mall. At least one-half of the required exit width for buildings connected by a covered mall shall lead to the outside by means other than through the mall. The covered mall connecting buildings shall have not less than two independent exits located as remotely as practical from each other. These exits shall have a total width equal to that required for the exits from all buildings within 100 feet travel distance to the mall exits. The maximum distance of travel to an exit measured within the mall shall not exceed 200 feet. To provide free travel in the mall to the outside, each side of the mall floor area shall be provided with unobstructed space, not less than 12 feet wide parallel to the building lines and extending to the exit from the mall. This floor shall be designed to carry the weight of fire trucks.

I-301.2 Exits.

- (a) The occupant load for the covered mall building, assuming all portions including individual tenant spaces and the mall to be occupied at the same time, shall be determined by dividing the gross area by 30 for covered mall buildings containing up to 150,000 square feet of gross area, by 40 for covered mall buildings containing between 150,001 and 350,000 square feet of gross area, and by 50 for covered mall buildings containing more than 350,000 square feet of gross area. Exit requirements for the gross leasable area of the covered mall building shall be based on the occupant load thus determined. The occupant load of anchor stores opening into the mall shall be based on other provisions of this Code and need not be included in computing the total number of occupants for the mall.
- (b) For exit purposes, the mall may be considered to be a public way.
- (c) The maximum distance of travel from any point within a mall to the exterior, an exit enclosure, a horizontal exit or an exit passageway shall not exceed 200 feet.
- (d) Each individual occupancy within the covered mall building shall be provided with exits in accordance with other provisions of this Code. Travel distance may be measured to the entrance to the mall.

I-301.3 Egress doors.

- (a) One-half of the required units of exit width for tenant spaces connected to a covered mall shall lead to the outside by means other than through the mall, except that when a tenant space does not exceed 2,250 square feet in area and the distance of travel from any point in

the space to the entrance to the mall does not exceed 75 feet, only one egress door shall be required.

- (b) When a tenant space is located at the intersection of two covered malls or has exposure on two different covered malls, such tenant space, when in excess of 2,250 square feet in area, shall have at least two separate egress doors both of which may lead through the covered malls providing the egress doors are located as remote from each other as practical.
- (c) Anchor stores shall provide the required number and width of exits directly to the exterior. The occupant load of anchor stores opening into the mall shall not be included in determining exit requirements for the mall.
- (d) The dead-end length of a mall shall not exceed twice its width.
- (e) The total width of exit doors from a covered mall building shall be sufficient to accommodate the entire calculated occupant load exclusive of the anchor stores.
- (f) The minimum exit width from a mall shall be 66 inches.
- (g) The aggregate required width of exits shall be divided approximately equally around the mall.
- (h) When exit passageways are present to provide a secondary exit from a tenant space, doors to the corridor shall be 1-hour fire doors. Such doors shall be self-closing and be so maintained or shall be automatic closing by smoke detection.
- (i) Storage is prohibited in exit corridors, which are also used for service to the tenants. Such corridors shall be posted with conspicuous signs so stating.
- (j) Tenant spaces, requiring more than one exit, may have one of the exits through an adjoining or intervening room that provides a direct, obvious and unobstructed means of travel to an exit corridor, exit enclosure or until egress is provided from the building, provided the exit does not pass through the restrooms, kitchens, closets or spaces used for similar purposes.

I-301.4 Mall width.

- (a) The minimum width of the mall shall be 30 feet.
- (b) There shall be a minimum of 12 feet clear exit width to a height of 8 feet between any projection of a tenant space bordering the mall to the nearest kiosk, vending machine, bench, display opening or other obstruction to exit travel.
- (c) The mall width shall be sufficient to accommodate the occupant load emptying into the immediately adjacent mall as determined by Section 803.

SECTION I-401 SMOKE VENTING

I-401.1 Smoke-control system. A mechanically operated air-handling system shall be installed in covered mall buildings, which will restrict the movement of smoke to the general area of fire origin and maintain the egress system in a condition that is safe.

I-401.2

- (a) The smoke-control system shall be designed in accordance with Section 720. The smoke-control system shall go into operation immediately following actuation of the smoke detector. The smoke-control system shall be as follows:

Smoke detectors shall be provided as follows:

1. A minimum of one area-type smoke detector in each tenant space having an opening to the mall. Such detector shall be located at each opening to the mall.
 2. Area-type smoke detectors or approved projected beam detectors shall be installed to monitor the mall area that can contain combustible loading, such as kiosks or displays. Such installations shall be engineered to distinguish fire in the mall from fire in the tenant space.
- (b) The smoke-control equipment for the mall shall be separate from that serving tenant spaces.
 - (c) The covered mall building shall be compartmented into smoke-control zones. Smoke-control zones shall be separated from each other by construction having a fire-resistive time period of not less than 1 hour. Walls between tenant spaces used to separate smoke-control zones shall extend from the floor to the underside of the floor or roof above.
 - (d) A smoke barrier shall be provided separating the tenant ceiling space from the mall ceiling space.
 - (e) A smoke-control zone shall coincide with the area of coverage of a single sprinkler supply. Within that sprinkler zone, there may be one or more air-moving systems, but no single smoke-control zone shall be larger than the sprinkler area.

I-401.3 Acceptance testing. The equipment shall be tested in accordance with Subsection 702.18. Final acceptance of the system shall be in the presence of the Building Official to confirm that the system is operating in compliance with the requirements of this Subsection.

the covered mall building prior to occupancy of any of the tenant spaces. Unoccupied tenant space shall be similarly protected unless provided with approved alternative protection.

SECTION I-601 HOSE CONNECTIONS

I-601.1 There shall be a hose outlet connected to a supply capable of delivering 250 gallons per minute at each of the following locations:

- (a) Within the mall at the entrance to an exit passage or exit corridor.
- (b) At each floor level landing within enclosed stairways opening directly onto the mall.
- (c) Adjacent to principle exterior entrances to the mall.

I-601.2 Hose outlets shall be installed to comply with the requirements of NFPA 14 with regard to materials, installation methods and testing.

Exceptions:

1. Risers and laterals of standpipe systems not located within an enclosed stairway need not be protected by a degree of fire resistance equal to that required for vertical enclosures in the covered mall building.
2. In buildings where more than one standpipe is provided, they need not be interconnected.
3. Piping may be hydraulically sized.

SECTION I-501 AUTOMATIC FIRE SUPPRESSION SYSTEMS

I-501.1 The covered mall building shall be provided with an automatic fire suppression system conforming to the provisions of NFPA 13. In addition to these provisions, the automatic fire suppression system shall comply with the following:

- (a) All automatic fire suppression system control valves shall be electrically supervised by an approved central station, proprietary or remote station alarm service, which will give an audible signal at a constantly attended station. (See NFPA 71 or 72.)
- (b) The automatic fire suppression system shall be complete and operative throughout all occupied space in

APPENDIX J

GROUP S-4 OCCUPANCIES AND MANUFACTURED BUILDINGS

SECTION J-101 ADMINISTRATIVE REQUIREMENTS

J-101.1 Scope. The provisions of this Appendix shall apply to:

- (a) Group S-4 occupancies including mobile homes, campers, trailers and manufactured buildings not intended for human occupancy; and
- (b) Manufactured buildings used for occupancies other than Group S-4.

J-101.2 Definitions.

- (a) **Cluster.** The locating of two or more individual units or groups with allowable separation, connected by a common walkway or deck that may be used by one or more tenants.
- (b) **Grouping.** The physical connecting of two or more independent units, with no separation between units, to form one larger unit for use by a single tenant; excluding those units designed and manufactured as multiple units when assembled to become one unit.
- (c) **Kiosk.** A kiosk is defined as a small structure, no larger than 200 square feet, which may be portable through more extensive disassembly, but is primarily intended as permanent. It may be constructed on- or off-site, then anchored and connected to utilities as permanent.
- (d) **Manufactured building.** A structure, transported on a separate vehicle in one or more sections, designed to be used as dwelling, commercial, institutional, storage, industrial structures with permanent foundation, which may include plumbing, heating and air conditioning, and electrical manufactured in accordance with the Florida Manufactured Building Act of 1979, in Section 553, Part IV, of the Florida Statutes, and administered and promulgated by the Rules and Regulations of the Florida Department of Business and Professional Regulation (DBPR).
- (e) **Mobile home.** Any residential unit constructed to standards promulgated by the U.S. Department of Housing and Urban Development, and administered by the Florida Department of Transportation and the DBPR.
- (f) **Recreational vehicle.** A vehicular-type unit primarily designed as temporary living quarters for recreational, camping or travel use, which either has its own motive power, or is mounted on or towed by another vehicle. The basic entities are: travel trailer, camping trailer, truck camper and motor home as defined in Chapter 320 of the Florida Statutes.
- (g) **Shed.** A shed is defined as a manufactured or site-built building not exceeding 200 square feet in size, and is used only for storage.

(h) **Temporary construction trailers.** A temporary building used for construction purposes has been defined as any building or shed that is temporary, does not exceed 8 feet in width and 32 feet in length, is used for the storage of materials and equipment, and may include a small office for a construction superintendent to use for functions that are exclusively for construction purposes. Temporary manufactured buildings, which meet this definition, are exempt from the requirements of the following: accessibility, DBPR approval, sealed engineering, energy calculations and emergency egress illumination.

(i) **Trailer.** An automotive drawn vehicle, mounted on wheels, designed to serve wherever parked as a dwelling.

J-101.3 Permits.

- (a) Mobile homes and manufactured buildings hereafter located in the District, installed for more than 10 days, shall require a permit. Temporary installations less than 10 days shall not require a permit unless electrical and/or plumbing connections are supplied to the trailer. Any supporting electrical, mechanical or plumbing shall require a separate permit, regardless of the number of days that the mobile home, trailer or manufactured building is in use. Regardless of the number of days in use, the trailer or manufactured building shall meet the requirements of the *EPCOT Accessibility Code for Building Construction*.
- (b) Each application for a permit shall be accompanied by two sets of plans that show the anchoring, piers and tie downs from the manufacturer, and a site or location plan.

J-101.4 Inspections. Mobile homes, manufactured buildings and other occupied mobile units shall be inspected by the Department of Building and Safety before utilities are connected, and when changes of tenancy occur prior to activation of electric power.

J-101.5 Manufactured buildings more than three sections wide or 3,200 square feet shall be fully sprinklered in accordance with EPCOT Standard 7-10.

J-101.6 Annual inspections. All permanent mobile homes, manufactured buildings and structures shall be inspected on an annual basis by the Reedy Creek Department of Building and Safety.

Exception: Temporary construction trailers and structures, temporary trailers or manufactured structures are exempt from the annual inspection requirement.

J-101.6.1 Annual inspection fees shall be charged in accordance with the Department of Building and Safety inspection fee schedule for annual inspections.

Exception: Group R-3 occupancies shall be exempt from annual inspection fees.

SECTION J-201 STANDARD ADOPTED

J-201.1 Purpose.

- (a) Mobile homes and manufactured buildings, because of the manner of their construction, assembly and use, and that of their systems, components and appliances (including heating, plumbing and electrical systems) like other finished products having concealed vital parts, may present hazards to the health, life and safety of persons, and to the safety of property unless properly manufactured. It is the policy and purpose of the District to provide protection to the public against possible hazards and, for that purpose, to prohibit the location of mobile homes that are not so constructed as to provide reasonable safety and protection.
- (b) There is hereby adopted the recommended principles of construction issued as ANSI A119.1 and amended from time to time by the American National Standards Institute (ANSI), successor to the U.S. American Standards Institute (USASI), applicable to mobile homes as defined herein.

J-201.2 Scope.

- (a) No person, firm or corporation may manufacture or locate any mobile home that has been constructed unless such mobile home, its components, systems and appliances have been constructed and assembled in accordance with the Standards herein defined.
- (b) Any mobile home or manufactured building that bears the label or seal of compliance of a recognized testing laboratory having follow-up inspection services approved by the District (such as Underwriter's Laboratories, Inc., or similar testing service) shall be deemed to be in full compliance with the standards and rules and regulations prescribed herein. All mobile home units bearing such label or seal shall be acceptable as meeting these requirements without further inspection or fees except where required for zoning, utility connections, foundation and anchorage permits. Any mobile home unit not bearing such label or seal shall be subject to inspection by the Department of Building and Safety for compliance with the herein described Standard.

SECTION J-301 BLOCKING AND ANCHORING TRAILERS, AND SECURING MOBILE HOMES AND TRAVEL TRAILERS

J-301.1 Piers, tie downs and anchors. All foundation systems for mobile homes shall be installed by a licensed installer and shall be in accordance with the mobile home manufacturer's approved plans. For manufactured buildings, the foundation system shall be in accordance with this Code, and with plans and calculations signed and sealed by a Florida professional engineer or registered architect. All anchoring products shall be approved by the Building Official.

- (a) Mobile homes and manufactured buildings shall be placed upon piers, anchored and secured in accordance with the following provisions within 10 days after

locating in a trailer park or other approved area, or within 4 hours after the issuance of a hurricane alert by the U.S. Weather Bureau, whichever may be sooner.

- (b) Travel trailers, during the official hurricane season (June 15 to November 15) shall be placed upon piers, anchored and secured in accordance with the following provisions within 10 days after locating in a trailer park or other approved area, or within 4 hours after the issuance of a hurricane alert by the U.S. Weather Bureau, whichever may be sooner.
- (c) The following shall be the minimum standards for blocking, anchoring and securing mobile homes, manufactured buildings and travel trailers:

1. Piers.

- 1.1. Pier foundations shall be installed directly under the main frame (or chassis) of the mobile home, manufactured building or travel trailer. The piers shall not be farther apart than 10 feet on centers, and the said main frame (or chassis) front or back, shall not extend farther than 5 feet beyond the center line of the end piers.
- 1.2. All grass and organic material shall be removed and the pier foundation placed on stable soil. All piers shall be placed on footings of solid concrete not less than 16 inches by 16 inches by 4 inches or an approved pad.
- 1.3. Piers less than 40 inches in height shall be constructed of open- or closed-cell, 8-inch by 8-inch by 16-inch concrete blocks (with open cells placed vertically upon the footer). Single-stacked block piers shall be installed within the 16-inch dimension perpendicular to the main (I-beam) frame. The piers shall be covered by a 2-inch by 8-inch by 16-inch-long pressure-treated wood cap or with an 8-inch by 16-inch by 4-inch solid concrete cap. Leveling shims shall be pressure-treated wood or an approved plastic wedge not exceeding 1½ inches in height. The steel frame shall not be in direct contact with concrete.
- 1.4. Piers between 40 and 80 inches in height and all corner piers more than three blocks high shall be double blocked with blocks interlocked and capped with a 4-inch by 16-inch solid concrete block.
- 1.5. Piers more than 80 inches in height shall be constructed in accordance with Paragraph 1.4, and they shall be laid in concrete mortar and steel reinforcing bars inserted in block cells filled with concrete.

- 2. **Tie downs.** Tie-down anchors shall be placed in accordance with approved manufacturer's plans and/or FAC 15C-1. Tie-down straps shall not be in direct contact with concrete.
- 3. **Ground anchors.** An approved ground anchor shall be one of the following:

- 3.1. A steel screw auger with a minimum $\frac{5}{16}$ -inch-diameter rod with welded eye on one end and a minimum auger diameter of 6 inches on the other end. The auger shall penetrate at least $3\frac{1}{2}$ feet below the ground surface.
- 3.2. A steel $\frac{5}{16}$ -inch-welded eyebolt with a 6-inch hook or a steel U-shaped, $\frac{5}{8}$ -inch rod with two 3-inch hooks, cast into a reinforced 4-inch concrete slab not less than 75 square feet in area.
- 3.3. A steel $\frac{5}{8}$ -inch-welded eyebolt or a steel U-shaped, $\frac{5}{8}$ -inch rod, cast 6 inches into a poured-in-place rock concrete dead-man at least 6 inches in diameter and 2 feet deep.
- 3.4. Other types of ground anchors may be approved by the Building Official if he deems them the equivalent of the foregoing specifications.

When the manufacturer's installation instructions are not available, piers, blocking, tie downs and ground anchors shall be installed in accordance with the Division of Motor Vehicles Bureau of MH/RV Construction Installer Licensing Program.

J-301.2 Notice of regulations to park occupants. Trailer or mobile home park owners or operators shall notify all park occupants at time of occupancy of the provisions of these regulations and shall post copies of these regulations in conspicuous locations within the park.

SECTION J-401 TRAILER PARKS AND CAMPING FACILITIES

J-401.1 Compliance. Trailer parks and camping facilities shall comply with the provisions of the Land Use Regulations of the District and, in addition, each installation shall be in accordance with the provisions of this Code, the *EPCOT Plumbing Code*, the *EPCOT Electrical Code* and the *EPCOT Fuel Gas Code*.

SECTION J-501 GROUP S-4 OCCUPANCIES

J-501.1 Scope. This Section shall apply to Group S-4 occupancies, including mobile homes, unoccupied manufactured buildings, recreational vehicles, trailers and sheds.

J-501.2 Requirements.

J-501.2.1 Access. Access to mobile homes, manufactured buildings, recreational vehicles and trailers shall be in accordance with Subsection 1407.1 of the *EPCOT Fire Prevention Code*.

J-501.2.2 Separation. Separation between mobile homes, manufactured buildings, recreational vehicles, trailers and other similar units shall be a minimum horizontal, clear and unobstructed distance of 15 feet.

J-501.2.3 Separation between mobile homes, manufactured buildings, recreational vehicles and trailers and a

permanent structure shall be a minimum horizontal, clear and unobstructed distance of 25 feet.

Exception: When the permanent structure has a fire-rated wall exposed to the Group S-4 occupancy, the distance may be reduced to 15 feet with the Building Official's approval.

J-501.2.4 Electrical systems. All applicable electrical systems and equipment shall be in accordance with the *EPCOT Electrical Code*.

J-501.3 Cluster or grouping.

J-501.3.1 Mobile homes, recreational vehicles, trailers and manufactured buildings may be arranged in clusters and/or groups when a minimum fire water flow of 1,000 gallons per minute is accessible.

J-501.3.2 Covered walkways, platforms and decks shall be sprinkled and square footage shall be added to square footage of units since they are considered as one building.

J-501.3.3 Separation of groups or clusters shall be in accordance with this Section.

J-501.3.4 Construction site locations. All such units covered by this Chapter and utilized as construction offices or storage facilities shall comply with the separation requirements set forth in this Section.

J-501.3.5 Semi-trailers. Semi-trailers used for storage may be parked in groups of four trailers with a minimum separation between groups of 15 feet.

SECTION J-601 MANUFACTURED BUILDINGS

J-601.1 Occupancy. Manufactured buildings shall have their occupancy classification based on the actual use of the structure.

J-601.2 Manufactured buildings less than four units wide or containing less than 3,200 square feet in area shall be provided with an approved single-station or multiple-station smoke detector installed in all common areas of the structure and in accordance with NFPA 72. The smoke detector(s) shall be located and installed in accordance with the manufacturer's recommendations. Where more than one detector is required, the detectors shall be wired in such a manner that the actuation of any detector will actuate all smoke detector notification alarms on the same circuit. The notification alarm shall be a combination audible/visual notification appliance. The audible signal shall be temporal, the visual indicator shall be a strobe rated at 177 candelas. These smoke detectors shall receive their operating power from a dedicated AC power breaker, and shall be supervised and remotely monitored.

Exception: With the approval of the Building Official, monitoring may not be required.

J-601.3 Manufactured buildings four or more units wide or greater than or equal to 3,200 square feet shall be provided with a fire sprinkler system and a fire alarm system complying with Section 1418 of the *EPCOT Fire Prevention Code*.

(a) If the combined cubic feet per minute of the air-handling units exceeds 15,000, complete area smoke

detection is required in lieu of duct detectors, and any smoke detector in alarm will shut down all air-handling units.

■ **J-601.4 Occupancy separation.** Manufactured buildings shall have the following separations:

- (a) Minimum of 25 feet between any manufactured building and a permanent building.
- (b) Minimum of 15 feet between any manufactured building.

■ **J-601.5 Decks and canopies.** Manufactured buildings interconnected with combustible decking or an overhead awning shall have the total square footage of the decks, canopies or awnings added to the area of the manufactured building(s) to determine compliance with Section 1420 of the *EPCOT Fire Prevention Code*.

Exception: Any connecting combustible walkway not more than 5 feet in width without an overhead awning.

SECTION J-701 KIOSKS

J-701.1 Requirements. Kiosks and similar structures (temporary or permanent) shall meet the following requirements:

- (a) Combustible kiosks or other structures shall not be located within buildings unless constructed of the following materials:
 - 1. Fire-retardant-treated wood complying with Section 1010.
 - 2. Foam plastics having a maximum heat-release rate not greater than 100 kilowatts when tested in accordance with the exhibit booth protocol in UL 1975.
 - 3. Aluminum composite material (ACM) having a flame spread index of not more than 25 and a smoke-developed index of not more than 450 when tested as an assembly in the maximum thickness intended for use in accordance with ASTM E84 or UL 723.
- (b) Where located within a building and a roof or cover equal to or greater than 16 square feet is provided on the kiosk or similar structure, automatic fire suppression and detection must be installed within the kiosk. Standalone kiosks outdoors do not require automatic fire suppression.
- (c) Kiosks installed outside of buildings shall be designed to meet the wind design criteria in accordance with Section 904 for permanent or temporary structures, respectively.

APPENDIX K

TENTATIVE REQUIREMENTS PERTAINING TO HEAT RADIATION BETWEEN BUILDINGS

This Appendix is reserved for the location of tentative requirements pertaining to heat radiation between buildings as may be computed and accepted as an alternative to those specific separation distances shown in Table 6.2.

APPENDIX L

TENTATIVE DESIGN CRITERIA FOR FIRE PROTECTION OF EXTERIOR STRUCTURAL ELEMENTS

SECTION L-101 OBJECTIVE

L-101.1 Objective.

- (a) The objective of this Section is to establish acceptable design rules for estimating the temperature rise of exterior structural elements when used without fire-resistive protection. It is hereby recognized that an alternative approach to basic fire protection design may be an analysis of external heat transfer and calculation of the amount of protection, if any, which is needed.
- (b) Where it is determined that fire protection is needed, it shall be provided in accordance with EPCOT Standard 6-1.

SECTION L-201 APPROVED OCCUPANCIES AND FIRE LOADS

L-201.1 Approved occupancies and fire loads.

- (a) Fire load shall be calculated for each floor of the building and shall be based on the higher of the fire loadings for the occupancy classifications as set forth in Paragraph (b). Minor accessory areas for which the fire loading exceeds the fire loading of the principal occupancy shall be permitted when complying with the provisions of Subsection 502.1(c).
- (b) For the purpose of this Section, design analytical methods shall be limited to the following building occupancies, and the fire loading shall be as set forth herein.

A-1	10 pounds per square foot of floor area
A-2	10 pounds per square foot of floor area
A-3	10 pounds per square foot of floor area
A-4	10 pounds per square foot of floor area
AA	10 pounds per square foot of floor area
B-1	Mercantile — 20 pounds per square foot of floor area
B-1	Office Buildings — 10 pounds per square foot of floor area
B-2	Mercantile — 20 pounds per square foot of floor area
B-2	Office Buildings — 10 pounds per square foot of floor area
D-1	10 pounds per square foot of floor area
D-2	10 pounds per square foot of floor area

D-3 10 pounds per square foot of floor area

E-1 10 pounds per square foot of floor area

E-2 10 pounds per square foot of floor area

E-3 10 pounds per square foot of floor area

R-1 10 pounds per square foot of floor area

R-2 10 pounds per square foot of floor area

R-3 10 pounds per square foot of floor area

SECTION L-301 CRITERIA ADOPTED

L-301.1 Criteria. Exterior structural steel elements. The fire endurance of exterior steel elements may be determined by analytical methods and procedures set forth in “Fire Safe Structural Steel,” *A Design Guide*, First Edition, March 1979, as published by the American Iron and Steel Institute.

SECTION L-401 ADMINISTRATIVE REQUIREMENT

L-401.1 The design of exterior structural steel elements in accordance with the criteria set forth in this Section shall be signed and sealed by a registered architect or engineer who is qualified in the field of fire protection design and practice. Evidence of this qualification shall be provided to the Building Official upon application for plan review.

APPENDIX M

REGULATIONS FOR CONSTRUCTION OF MOTION PICTURE AND TELEVISION SOUNDSTAGES

SECTION M-101 ADMINISTRATIVE REQUIREMENTS

M-101.1 Scope. This Appendix shall apply to the construction, alterations, repair and maintenance of motion picture television soundstages, hereinafter referred to as studios.

M-101.2 Definition.

- (a) **Studio.** An establishment, room or building in which motion pictures are made, or where radio or television programs are produced or where recordings are made.

M-101.3 Criteria. The requirements of this Appendix shall supplement the provisions of this Code. Where there is a conflict between the provisions of this Code and Appendix, the requirements of this Appendix shall apply.

M-101.4 Design. The design of studios, theaters, theater stages, enclosed platforms and motion picture projection rooms shall comply with Chapter 9.

M-101.5 Construction of materials. The type of construction and materials of construction shall conform to the requirements as set forth in Section M-201 and as defined in this Code.

M-101.6 Exits. Exits shall be provided in accordance with Section M-301.

M-101.7 Fire protection. Fire protection of structural members shall be as set forth in Chapter 6 and EPCOT Standard 6-1.

M-101.8 Construction of theater stages, enclosed platforms, motion picture projection rooms and open-air event or performance platforms. Construction of theater stages, enclosed platforms, motion picture projection rooms and open-air event or performance platforms shall be in accordance with Appendix G.

M-101.9 Electrical wiring. Electrical wiring shall comply with the *EPCOT Electrical Code*.

SECTION M-201 DESIGN, CONSTRUCTION AND FIRE PROTECTION OF STUDIOS

M-201.1 Construction. Studios shall be Type I, II or IV protected.

M-201.2 Area and height.

- (a) Type I—no limit.
(b) Type II—no limit.
(c) Type IV Protected—no limit.
(d) A building containing a studio, as defined in this Appendix, requires a 60-foot separation on all sides from other buildings, of which 30 feet must be maintained clear.

M-201.3 Sprinkler requirements. Studios shall be sprinklered in accordance with NFPA 13 as extra hazard location.

- (a) Studio buildings shall be sprinklered above and below the grid system and catwalks. Catwalks less than 3 feet in width are exempt from this requirement.
(b) Fire hose cabinets shall have a 2½-inch outlet reduced to 1½ inches complete with 100 feet of hose.
(c) Fire hose cabinets shall be located so that all parts of the studio are within 20 feet of a nozzle attached to 100 feet of hose in accordance with NFPA 14.
(d) Fire hose cabinets shall be installed in all mechanical rooms.
(e) Studios shall be provided with sufficient quantity of 2½-inch outlets on each roof.

M-201.4 Design.

- (a) The design of roof, catwalk and grid system shall be for the maximum design loading. All design calculations shall be submitted prior to application for permit.
(b) Roof design loads shall be posted.
(c) Catwalk and grid design loads shall be posted.
(d) All structural members shall be designed with the provisions of Chapter 9.

M-201.5 Catwalks and grids. Catwalk and grid systems shall be of noncombustible construction. Fire-retardant-treated lumber shall not be used as a substitute for noncombustible.

M-201.6 Floor drains. Studios shall be provided with one floor drain for each 7,000 square feet or fraction thereof. Drains shall be connected to holding ponds of sufficient design and capacity.

M-201.7 Clearance. The location of all sets, cycloramas and scenery inside a studio shall be approved by the Reedy Creek Fire Prevention Division and the Department of Building and Safety.

M-201.8 Interior finish. Soundproofing of walls shall be fiberglass or fire-retardant cloth covered with chicken wire. Interior finishes and sets shall not be less than Class III in accordance with Section 711.

SECTION M-301 EXITS AND EMERGENCY LIGHTING

M-301.1 Exits.

- (a) Studios shall have exits located at not more than 100 feet intervals on all perimeter walls. All exits shall be installed in accordance with Chapter 8.

- (b) Catwalks shall have at least two means of exit, one of which may be a ladder. No catwalk shall have more than one 20-foot dead end.

1. Maximum travel distance on catwalks to 200 feet.
2. A width of not less than 22 inches is permitted.

- (c) All exit doors shall be a minimum of 36 inches in width.

M-301.2 Emergency lighting.

- (a) All exits shall be equipped with approved exit signs in accordance with Section 812 and the *EPCOT Electrical Code*.
- (b) Studios shall be provided with emergency illumination of not less than 1 footcandle intensity at the floor level and on the stairs.

**SECTION M-401
SEATING AREAS**

M-401.1 Spacing. Spacing of seats shall be in accordance with Section 816.

M-401.2 When a live audience is present, there shall be available a minimum of two exterior exits on opposite sides of the seating area.

M-401.3 Each seating area is to have two rear exits plus two front exits.

M-401.4 Occupant load. The maximum occupancy load for any live audience show shall be limited by an approved seating plan approved by the Reedy Creek Fire Prevention Division and the Department of Building and Safety. Any studio with permanent fixed seating shall have the occupant content determined as set forth in Chapter 8.

APPENDIX N

REGULATIONS FOR MEMBRANE STRUCTURES AND TENTS

SECTION N-101 ADMINISTRATIVE

N-101.1 Scope. This Appendix shall apply to permanent and temporary air-supported, air-inflated and tensioned-membrane structures, collectively known as membrane structures; tents greater than 400 square feet used as complete buildings; and as roofs or other portions of buildings or other types of construction. Tents and membrane structures shall also comply with the applicable provisions of EPCOT Standard 5-8 not otherwise covered by this Appendix.

N-101.2 Plans and specifications. A site plan detailing the location of the tent in relation to buildings and parking, a floor plan and a complete scope of work shall be submitted.

A description of the intended use of the tent with complete interior floor plan showing, but not limited to, exits, aisles, doors, kitchens, stages or performance platforms, light trusses, scaffolds, pyrotechnic locations, tables and seating shall also be indicated on the plans.

N-101.3 Definitions. For the purpose of this Appendix, the following terms shall have the meanings indicated in this Section. Other terms shall be as defined in the Chapter 2 or shall have their ordinarily accepted meanings as the context may imply.

- (a) **Air-inflated structure.** A building or portion thereof whose shape is maintained by air pressurization of unoccupied cells or tubes. A system of cables, bands, webbing, ropes or similar tensile elements may be used to restrain the membrane and transfer the tensile forces to supports.
- (b) **Air-supported structure.** A building or portion thereof whose shape is attained by air pressure and where the pressurized space may be occupied. A system of cables, bands, webbing, ropes or similar tensile elements may be used to restrain the membrane and transfer the tensile forces to supports.
- (c) **Tension membrane structure.** A nonpressurized membrane structure wherein the membrane is pre-stressed and the structural support system includes cables and/or rigid elements to maintain the structural form.
- (d) **Tent.** Any structure, enclosure or shelter constructed of canvas or pliable material supported by any manner, except by air or the contents it protects.

N-101.4 Criteria. The requirements of this Appendix shall supplement the provisions of this Code. Where there is a conflict between the provisions of this Code and Appendix, the requirements of this Appendix shall apply.

N-101.5 Design. The design of membrane structures shall comply with Section N-201 and Chapter 9.

N-101.6 Construction and materials. The type of construction and materials of construction shall conform to the

requirements as set forth in Section N-201 and as defined in this Code.

N-101.7 Exits. Exits shall be provided in accordance with Chapter 8.

N-101.8 Exit signage. All exits shall be clearly marked with exit signage. Tents with 750 square feet or more shall illuminate all exit signs and have a back-up power supply.

Exception: Open-sided tents.

N-101.9 Egress illumination. See Section 813 for egress illumination requirements.

N-101.10 Occupant load. Tents containing 750 square feet or more shall post the maximum occupant load complying with Section 802.

N-101.11 Fire department access. Fire Department access lanes shall remain clear between tents, or tents and structures.

N-101.12 Electrical. Electrical wiring shall comply with the *EPCOT Electrical Code*.

N-101.13 Fire protection. All membrane structures shall be in accordance with Subsection 503.13.

N-101.14 Mechanical. Heating, ventilating and air-conditioning installations shall conform to the requirements of the *EPCOT Mechanical Code*.

N-101.15 Temporary toilet fixtures. Additional permanent or temporary toilet fixtures shall be provided in accordance with *EPCOT Plumbing Code* Table 403.1 when the temporary occupant load is in addition to the original occupant load.

SECTION N-201 MATERIALS

N-201.1 General. All material used in the construction of membrane structures shall conform to the requirements of this Section or to applicable provisions of this Code.

N-201.2 Membrane. All membranes shall be classified as either Class I or II.

N-201.3 Class I. A Class I membrane shall comply with the requirements of Subsections N-201.7, N-201.8, N-201.9 and N-201.10.

N-201.4 Class II. A Class II membrane shall comply with the requirements of Subsections N-201.7, N-201.9 and N-201.10.

N-201.5 Interior liners. All interior liners, installed for decorative, acoustical, thermal insulation or other purposes shall comply with the requirements of Subsections N-201.6, N-201.8 and N-201.9.

N-201.6 Testing. All membranes shall be tested for flammability in accordance with the provisions of this Section.

N-201.7 Flame resistance. Membranes shall perform as specified in Table N-1 when tested in accordance with the provisions of the large and small scale tests of EPCOT Stan-

Standard 5-8. Membranes shall be tested both as produced and after accelerated weathering in accordance with EPCOT Standard 5-8.

The test report shall contain the actual performance of the fabric for each criteria.

The test shall be conducted with the following additional provisions:

- (a) Place a horizontal layer of dry, absorbent surgical cotton 12 inches below the bottom edge of the specimen. The cotton layer shall be approximately 20 inches square with a freestanding thickness of $1\frac{1}{4}$ inch.
- (b) No test specimen shall drip molten or flaming particles that ignite the cotton.

TABLE N-1
NFPA 701 CRITERIA

Maximum After Flame	2.0 seconds
Maximum Melt/Drip Flame Time	0.0 seconds
Maximum Length of Char or Destroyed Material	
Maximum Average of 10 Specimens	$3\frac{1}{2}$ inches
Maximum for Any Specimen	$4\frac{1}{2}$ inches

N-201.8 Combustibility. Membranes shall have a base fabric of material meeting the test requirements set forth in ASTM E136. The coated fabric shall have a potential heat of not more than 3,000 Btu/ft² as determined by tests conducted in accordance with NFPA 259.

N-201.9 Exterior exposure. All membranes shall be classified as to their resistance to exterior fire exposure when tested in accordance with ASTM E108. The minimum classification for membranes shall be Class C. The tests shall be conducted at a slope of 5:12. The test decks and conditions of classification of ASTM E108 shall be modified as follows:

(a) Test decks.

1. Membranes shall not be tested over a deck. Membranes shall be stretched over a frame to provide a test panel of the size specified for the test deck for the specific test being conducted.
2. Membranes limited to use for air-supported structures may be attached to the top of an air-tight chamber to provide a test panel of the size specified for the test being conducted. The chamber shall be pressurized to a level representative of the in-use conditions. The side and end panels of the chamber shall be of a material to enable viewing of the underside of the fabric test specimen.
3. Membranes limited to use for air-inflated structures may be attached to a frame to provide a test panel of the size specified for the test being conducted and inflated to a pressure representative of the in-use pressure.

(b) Conditions of classifications. A membrane material must meet the following conditions when subjected to the particular class of fire tests:

1. At no time during or after the intermittent flame, spread of flame or burning brand test shall any portion of the membrane material be blown off or fall through the test specimen in the form of flaming or glowing brands that continue to glow after reaching the floor; or portions of the membrane fall away in the form of particles that continue to glow after reaching the floor.
2. At no time during the Class A, B or C intermittent flame tests, or the Class A or B burning brand tests, shall there be sustained flaming of the underside of the membrane. If flaming does occur, conduct another series of tests, during which no sustained flaming shall occur.
3. In the Class C burning brand tests, there may be sustained flaming on the underside of the membrane of not more than 20 percent of the brands applied.
4. During the spread of flame test, the flaming shall not spread beyond 6 feet for Class A, 8 feet for Class B and 13 feet (the top of the membrane) for Class C. There shall be no significant lateral spread of flame from the path directly exposed to the test flame.

N-201.10 Flame spread. All membranes, including interior liners, exposed to the interior of the building shall have a flame spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E84. Membranes shall be mounted for testing on poultry netting as described in ASTM E84. Membranes shall not be bonded to a substrate.

SECTION N-301
DESIGN

N-301.1 General. Membrane structures that provide the complete enclosure for the occupied space shall be considered as complete buildings and subject to the requirements of this Section.

N-301.2 Location on property. Permanent membrane structures and tents shall have a horizontal separation greater than 30 feet.

Exception: Horizontal separations of 30 feet or less shall be permitted when an exterior wall is provided in accordance with Table 6.2 and the wall has a minimum fire-resistance rating of 1 hour. The exterior wall shall extend from ground level to the height where the slope of the tangent to the membrane structure or tent exceeds 30 degrees from the vertical, but in no case is less than 8 feet above the first-floor level.

There shall be a 15-foot minimum clear distance between temporary tents and permanent structures.

Temporary tents having an aggregate area of 15,000 square feet or more shall be located not less than 25 feet from

any other tent or 50 feet from any building or structure measured from the sidewall of the tent.

Exception: Exterior covered walkways without sidewalls may be used between tents or structures when not exceeding 15 feet in width and shall comply with all other separation requirements of this Section.

N-301.3 Height. Membrane structures and tents shall be limited to one story in height, but shall not be limited in number of feet to height.

N-301.4 Area. For determining allowable area, the construction type for a membrane structure shall be based on the support system. Air-supported membrane structures shall not exceed the allowable areas listed in Table 7.5 for Type IV unprotected construction.

N-301.5 Area increases permitted by Section 712 shall be permitted.

N-301.6 Occupancy separation. A permanent membrane structure building, which is occupied by more than one use group, shall comply with Section 502.

N-301.7 Mixed construction. Membrane structures shall be permitted to be utilized as specified in this Section as a portion of buildings of other types of construction. Height and area limits shall be as specified for the type of construction and occupancy of the building.

N-301.8 Class I membrane. A Class I membrane shall be permitted for use as the roof or as a skylight of any building or atrium of a building of any type of construction provided it is at least 20 feet above any floor, balcony or gallery, and has a horizontal separation greater than 15 feet from the edge of the membrane.

N-301.9 Class II membrane. A Class II membrane shall be permitted to be used as the roof or as a skylight on buildings of Types III, IV-Unprotected, V and VI construction provided it is at least 20 feet above any floor, balcony or gallery and has a horizontal separation greater than 15 feet from the edge of the membrane.

N-301.10 Air-inflated structures. Air-inflated, air-supported (inflatable) structures shall comply with the provisions of ASTM F2374.

SECTION N-401 STRUCTURAL

N-401.1 General. The design, materials and construction of the building shall be based upon plans and specifications by a licensed architect or engineer licensed by the state to practice as such.

N-401.2 Loads. The structure shall be designed and constructed to sustain all dead loads, loads due to tensioning or inflation, and live loads, including wind.

APPENDIX O

RESERVED

APPENDIX P

REGULATIONS COVERING BUILDING DEAD LOADS

SECTION P-101 OBJECTIVES

P-101.1 Purpose. The purpose of this Appendix is to ensure proper consideration of the building dead loads. The capacity of the building should be such that minor relocation of sprinklers, ducts, lights, or that minor interior decorating and remodeling will not require a structural check.

P-101.2 Scope. These loadings cover all buildings not specifically exempted by the Building Official. The loads are minimum and the structural engineer-of-record is responsible for all loadings and for ensuring larger loads are used if required. The loadings given will primarily be for systems, etc.

P-101.3 Special loads. The structural engineer-of-record shall see that any special considerations are addressed. These may be for equipment supports or systems that exceed the minimum, such as large ducts or large pipes that need to be supported beneath or suspended from above.

P-101.4 Drawings. On the drawings, each roof and floor plan shall show (preferably near the plan title) the design dead and live load. In the drawing notes, a typical floor and/or roof dead loads shall be broken down adequately to show how the design dead load was arrived at. This may include such items as roofing, framing, insulation, allowances for sprinklers, mechanical ducts, lights, wiring, ceilings or future ceilings, etc.

SECTION P-201 BUILDING DEAD LOAD REQUIREMENTS

P-201.1 Dead load minimum.

- (a) The dead loads used shall not be less than the actual constructed dead loads or reasonably anticipated loadings for that building to function at its permitted occupancy group.
- (b) All metal pre-engineered buildings shall use a 10-pound-per-square-foot (psf) collateral load or greater. The drawings shall show the design dead load of the framing system. The frame (purlins and girts are excluded) shall be capable of carrying a minimum 1,000-pound concentrated load on any point (not simultaneous with other live loads).
- (c) The following items, when used, shall not be less than the minimums given without special permission of the Building Official:

Steel Joist	3 psf
Mechanical Duct Allowance	4 psf
Sprinklers	1 psf
Lights	1 psf
Wiring	1psf
Ceilings	3 psf

APPENDIX Q

REGULATION OF ANIMAL SUPPORT FACILITIES

SECTION Q-101 ADMINISTRATIVE REQUIREMENTS

Q-101.1 Scope. The requirements of this Appendix shall apply to animal support facilities and their appurtenances hereafter constructed, erected, maintained, repaired or altered within the District. Such buildings and structures shall be classified as Group S, Division 8, in accordance with Table 5.1 and Subsection 516.1.

Q-101.2 Definition.

- (a) **Animal support facility.** A barn, stable, stall, room or building in which exotic, wild animals are housed, fed and maintained. Animal support facilities are distinguished from commercial stables and barns, and domestic tame animals as defined by Appendix H. Exterior corrals, paddocks or other fenced holding areas may be attached to these buildings.

Q-101.3 Criteria. The requirements of this Appendix shall supplement the provisions of this Code. Where a conflict may arise between the provision of this Code and Appendix, the requirements of the Appendix shall apply.

Q-101.4 Structural design. Structural design shall be subject to the requirements of Chapter 9. Structural design criteria for walls and fence assemblies providing animal containment shall be based on the following assumptions:

ANIMAL	HORIZONTAL FORCE	HEIGHT ABOVE GRADE OF LOAD APPLICATION
Bull Elephant	10,000 lbs	7'-0"
Female Elephant	8,000 lbs	7'-0"
Hippopotamus	4,000 lbs	4'-0"
Rhinoceros	4,000 lbs	4'-0"
Lion	500 lbs	5'-0"
Cheetah	100 lbs	4'-0"
Giraffe	1,600 lbs	8'-0"
All Other Animals	500 lbs	4'-0"

Q-101.5 Construction and materials. The type of construction and materials of construction shall conform to the requirements as set forth in Section Q-201 and as defined in this Code.

Q-101.6 Exits. Exits shall be provided in accordance with Section Q-301 and as defined in this Code.

Q-101.7 Fire protection. Fire protection of structural members shall be as set forth in Chapter 6 and EPCOT Standard 6-1.

Q-101.8 HVAC, plumbing, electrical design. Heating, ventilation, and air-conditioning (HVAC), plumbing and electrical design of buildings and structures housing Group S-8 occupancies shall be subject to the requirements of the *EPCOT*

Mechanical Code, the *EPCOT Plumbing Code* and the *EPCOT Electrical Code*.

SECTION Q-201 DESIGN, CONSTRUCTION AND FIRE PROTECTION

Q-201.1 Location on property. Building and structures housing Group S-8 occupancies shall be subject to the requirements of Chapter 7. The following exceptions shall apply for location on property and for fire protection of exterior openings:

- (a) Openings in walls of buildings housing Group S-8 occupancies shall not be required to be protected, except within 5 feet of an adjacent property line.
- (b) Roof eaves shall not extend beyond a point one-half the distance to the property line from an exterior wall, nor one-half the distance between adjacent Group S-8 buildings.
- (c) Minimum spacing between buildings housing Group S-8 occupancies shall be 16 feet.

Q-201.2 Construction. Building and structures housing Group S-8 occupancies shall be Type I, II, III or IV Unprotected.

Q-201.3 Area and height. Exterior corrals, paddocks or other fenced holding area attached to buildings and structures housing Group S-8 occupancies shall not be additive to calculated floor areas. If such exterior areas are partially or totally covered by extended roof structures integral with the building, the lines of primary structure supporting such roofed areas shall be considered "exterior wall lines" when determining location on property as set forth in Subsection Q-201.1.

(a) Type I	No Limit
(b) Type II	No Limit
(c) Type III	20,000 ft ² - 30 ft high
(d) Type IV Unprotected	26,000 ft ² - 30 ft high

Q-201.4 Use of materials. Interior and exterior stall and paddock fencing, doors and gates may be moisture-retardant-treated wood no less than 1½ inches net thickness secured to steel frames and supports as required.

Q-201.5 Sprinkler requirements.

- (a) Buildings and structures housing Group S-8 occupancies are not required to be provided with an automatic fire-extinguishing system, except at areas of the following usage:
 1. Rooms and/or spaces used for the storage of animal feed, such as sacked or openly stored grain and feed pellets, baled alfalfa and grain stalks, hay and straw bedding materials.

2. Rooms and/or spaces occupied by animal keepers, including spaces where keeper's tack, equipment, materials and supplies are stored.
 3. Rooms and/or spaces housing building services, including mechanical, hydraulic and electrical equipment.
- (b) Sprinkler design may be based on a fire protection system utilizing a 2-inch to 2½-inch riser from domestic water service if the total protected area requires 10 heads or less.

Q-201.6 Fire alarm systems. All buildings and structures housing Group S-8 occupancies shall be provided with smoke detectors installed in accordance with Subsection 503.12(b).

Exceptions:

1. A Fire alarm control panel is not required. Detectors and water-flow switch monitoring on sprinkler systems shall report back to a constantly attended monitoring station.
2. Local audible alarms shall not be installed due to the possibility of creating unnecessary panic among the animals. Strobe light(s) shall be installed as a local fire alarm notification in lieu of audible alarms.

SECTION Q-301 EXITS AND EMERGENCY LIGHTING

Q-301.1 Occupant load. Occupant load in buildings and structures housing Group S-8 occupancies shall be taken for spaces occupied by human keepers and handlers only. Animal population counts and spaces, including transfer and keeper aisles, do not contribute to calculation of occupant load.

- (a) All exits for human occupancy shall be installed in accordance with Chapter 8.
- (b) Catwalks shall have at least two means of exit, one of which may be a ladder. No catwalk shall have more than one 20-foot dead end.

Q-301.2 Exit signs and emergency lighting. Buildings and structures housing Group S-8 occupancies shall be equipped with approved exit signs and emergency illumination for spaces occupied by human keepers and handlers as required by Section 813 and the *EPCOT Electrical Code*.

APPENDIX R

SWIMMING POOLS AND BATHING PLACES

SECTION R-101 ADMINISTRATIVE REQUIREMENTS

R-101.1 Public swimming pools and bathing places. Public swimming pools and bathing places shall comply with the design and construction standards of this Section.

Note: Other administrative and programmatic provisions may apply. [See Department of Health (DOH) Rule 64E-9, Florida Administrative Code (F.A.C.) and Chapter 514 of the Florida Statutes (F.S.)]

Exceptions:

1. Private pools and water therapy facilities connected with facilities connected with hospitals, medical doctors' offices and licensed physical therapy establishments shall be exempt from supervision under this Appendix.
2. (a) Pools serving no more than 32 condominium or cooperative units, which are not operated as a public lodging establishment, shall be exempt from supervision under this Appendix, except for water quality.
(b) Pools serving condominium or cooperative associations of more than 32 units and whose recorded documents prohibit the rental or sublease of the units for periods of less than 60 days are exempt from supervision under this Appendix, except that the condominium or cooperative owner or association must file applications with the Department of Building and Safety and obtain construction plans approval and permitting.

R-101.2 Definitions—general.

ABOVE-GROUND/ON-GROUND POOL. See "Swimming pool."

BACKWASH PIPING. See "Filter waste discharge piping."

BARRIER. A fence, wall, building wall or a combination thereof that completely surrounds the swimming pool and obstructs access to the swimming pool.

BATHING LOAD. The maximum number of persons allowed in the pool or bathing place at one time.

BODY FEED. Filter aid fed into a diatomite-type filter throughout the filtering cycle.

CARTRIDGE FILTER. A filter using cartridge-type filter elements.

CHEMICAL PIPING. Piping that conveys concentrated chemical solutions from a feeding apparatus to the circulation piping.

CIRCULATION PIPING SYSTEM. Piping between the pool structure and the mechanical equipment. Usually includes suction piping, face piping and return piping.

COLLECTOR TANK. A reservoir, with a minimum of 2.25 square feet of water surface area open to the atmosphere, from

which the recirculation or feature pump takes suction, which receives the gravity flow from the main drain line and surface overflow system or feature water source line, and that is cleanable.

COMBINATION VALVE. A multipart valve intended to perform more than one function.

DESIGN HEAD. Total head requirement of the circulation system at the design rate of flow.

D.E. The Diatomaceous Earth that is used as a filter aid in D.E.-type filters. For the purpose of this definition, it also includes alternative filter aids that have been approved in accordance with NSF/ANSI Standard 50-2007, and accepted by the filter manufacturer.

DIATOMITE (DIATOMACEOUS EARTH). A type of filter aid.

DIATOMITE-TYPE FILTER. A filter designed to be used with filter aid.

EFFECTIVE BARRIER. A barrier that consists of a building, or equivalent structure, plus a 48-inch minimum height fence on the remaining sides or a continuous 48-inch minimum height fence. All access through the barrier must have one or more of the following safety features: alarm, key lock or self-locking doors and gates. Safety covers that comply with the American Society for Testing Materials Standard F 1346-91 (2003) may also be considered as an effective barrier.

FACE PIPING. Piping with all valves and fittings, which is used to connect the filter system together as a unit.

FILTER. Any apparatus by which water is clarified.

FILTER AID. A nonpermanent type of filter medium or aid, such as diatomite, alum, etc.

FILTER CARTRIDGE. A disposable or renewable filter element that generally employs no filter aid.

FILTER ELEMENT. That part of a filter that retains the filter medium.

FILTER MEDIUM. Fine material that entraps the suspended particles and removes them from the water.

FILTER RATE. Average rate of flow per square foot of filter area.

FILTER ROCK. Specially graded rock and gravel used to support filter sand.

FILTER SAND. A specially graded type of permanent filter medium.

FILTER SEPTUM. That part of the filter element in a diatomite-type filter upon which a cake of diatomite or other nonpermanent filter aid may be deposited.

FILTER WASTE DISCHARGE PIPING. Piping that conducts waste water from a filter to a drainage system. Connec-

tion to drainage system is made through an air gap or other approved methods.

FRESH WATER. Those waters having a specific conductivity less than a solution containing 6,000 parts per million (ppm) of sodium chloride.

HIGH RATE SAND FILTER. A sand filter designed for flows in excess of 5 gallons per minute per square foot (gpm/ft²).

HOT TUB. See “Swimming pool.”

IN-GROUND POOL. See “Swimming pool.”

INLET FITTING. Fitting or fixture through which circulated water enters the pool.

INTERACTIVE WATER FEATURES. A structure designed to allow for recreational activities with recirculated, filtered and treated water, but having minimal standing water. Water from the interactive fountain type features is collected by gravity below grade in a collector tank or sump. The water is filtered, disinfected and then pumped to the feature spray discharge heads.

MAIN OUTLET. Outlet at the deep portion of the pool through which the main flow of water leaves the pool when being drained or circulated.

MARKING OR MARKINGS. The placement and installation of visual marking cues to help patrons identify step, bench and swimout outlines, slope break location, depth designations, and “NO ENTRY” and “NO DIVING” warnings. When markings are specified by this Code to be dark, the term dark shall mean a Munsell Color Value from zero to four.

MODIFICATION. Any act that changes or alters the original characteristics of the pool as approved. For example, changes in the recirculation systems, decking, treatment systems, disinfection system and pool shape are modifications.

PERIMETER OVERFLOW GUTTER. A level trough or ledge around the inside perimeter of the pool containing drains to clean the pool water surface.

PLUNGE POOL. The receiving body of water located at the terminus of a recreational water slide.

POOL. See “Swimming pool.”

POOL DEPTHS. The distance between the floor of the pool and the maximum operating water level.

POOL FLOOR. The interior pool bottom surface, which consists of that area from a horizontal plane up to a maximum of a 45-degree slope.

POOL PLUMBING. All chemical, circulation, filter waste discharge piping, deck drainage and water-filling system.

POOL TURNOVER. The circulation of the entire pool volume through the filter system. Pool volume shall be determined from the design water level, which is the normal operating water level; for gutter-type pools, the design water level is the horizontal plane of the upper lip of the gutter and for skimmer pools it is the centerline of the skimmer opening.

POOL WALL. The interior pool side surfaces, which consist of that area from a vertical plane to a 45-degree slope.

PORTABLE POOL. A prefabricated pool that may be erected at the point of intended use and may be subsequently disassembled and re-erected at a new location. Generally, installed on the surface of the ground and without excavation.

PRECOAT. In a diatomite-type filter, the initial coating or filter aid placed on the filter septum at the start of the filter cycle.

PRECOAT POT. A container with a valved connection to the suction side of the recirculation pump of a pressure D.E.-type filter system used for coating the filter with D.E. powder or NSF/ANSI Standard 50-2007 and manufacturer approved substitute filter aid.

PUBLIC SWIMMING POOL OR PUBLIC POOL. A water-tight structure of concrete, masonry or other approved materials, which is located either indoors or outdoors, used for bathing or swimming by humans, and filled with a filtered and disinfected water supply, together with buildings, appurtenances and equipment used in connection therewith. A public swimming pool or public pool shall mean a conventional pool, spa-type pool, wading pool, special-purpose pool or water recreation attraction, to which admission may be gained with or without payment of a fee and includes, but is not limited to, pools operated by or serving camps, churches, cities, counties, day care centers, group home facilities for eight or more clients, health spas, institutions, parks, state agencies, schools, subdivisions, or the cooperative living-type projects of five or more living units, such as apartments, boardinghouses, hotels, mobile home parks, motels, recreational vehicle parks and townhouses. The term does not include a swimming pool located on the grounds of a private residence.

RAPID SAND FILTER. A filter designed to be used with sand as the filter medium and for flows not to exceed 5 gpm/ft².

RECEPTOR. An approved plumbing fixture or device of such material, shape and capacity as to adequately receive the discharge from indirect waste piping, so constructed and located as to be readily cleaned.

RECIRCULATION SYSTEM. The system of piping and mechanics designed to remove the water from the pool then filter, disinfect and return it to the pool.

RETURN PIPING. That portion of the circulation piping that extends from the outlet side of the filters to the pool.

SALINE WATER. Those waters having a specific conductivity in excess of a solution containing 6,000 ppm of sodium chloride.

SEPARATION TANK. A device used to clarify filter rinse or waste water. Sometimes called a reclamation tank.

SKIM FILTER. A surface skimmer combined with a vacuum diatomite filter.

SLIP RESISTANT. Having a textured surface that is not conducive to slipping under contact of bare feet unlike glazed tile or masonry terrazzo and nontextured plastic materials. Manufactured surface products shall be designated by the manufacturer as suitable for walking surfaces in wet areas.

SPA, NONPORTABLE. See “Swimming pool.”

SPA POOL. A pool used in conjunction with high-velocity air or water.

SPA, PORTABLE. Nonpermanent structure intended for recreational bathing, in which all controls, water heating and water circulating equipment are an integral part of the product and which is cord-connected (not permanently electrically wired).

SPECIAL-PURPOSE POOL. A public pool used exclusively for a specific, supervised purpose, including spring-board or platform diving training, SCUBA diving instruction, and aquatic programs for persons with disabilities, and preschool or kindergarten children.

SUCTION PIPING. That portion of the circulation piping located between the pool structure and the inlet side of the pump, and usually includes main outlet piping, skimmer piping, vacuum piping and surge tank piping.

SURFACE SKIMMER. A device generally located in the pool wall that skims the pool surface by drawing pool water over a self adjusting weir.

SWIM SPA. A pool used in conjunction with a directional flow of water against which one swims.

SWIMMING POOL. Any structure intended for swimming or recreational bathing that contains water more than 24 inches deep. This includes in-ground, above-ground and on-ground swimming pools, hot tubs and spas.

SWIMMING POOL, INDOOR. A swimming pool that is totally contained within a structure and surrounded on all four sides by walls of said structure.

SWIMMING POOL, OUTDOOR. Any swimming pool that is not an indoor pool.

SWIMMING POOL, PRIVATE. Any structure intended for and restricted to the use of a single dwelling unit, located in a residential area, that is intended for swimming or recreational bathing and contains water over 24 inches deep, including but not limited to inground, aboveground and onground swimming pools, hot tubs and nonportable spas.

SWIMMING POOL SLIDE. A slide designed by its manufacturer to discharge over the sidewall of a swimming pool.

SWIMMING POOL, RESIDENTIAL. That which is intended for noncommercial use.

TURNOVER TIME. The time, in hours, required for the circulation system to filter and recirculate a volume of water equal to the pool volume.

VACUUM FITTING. A fitting in the pool that is used as a convenient outlet for connecting the underwater suction cleaning equipment.

VACUUM PIPING. The piping from the suction side of a pump connected to a vacuum fitting located at the pool and below the water level.

WADING POOL. A shallow pool designed to be used by children.

WASTE PIPING. See “Filter waste discharge piping.”

WATER ACTIVITY POOL. A water recreation attraction that has water-related activities, such as rope ladders, rope swings, cargo nets and other similar activities.

WATER RECREATION ATTRACTION. A facility with design and operational features that provide patrons recreational activity and purposefully involves immersion of the body, partially or totally, in the water. Water recreation attractions include water slides, river rides, water course rides, water activity pools, interactive water features and wave pools, and any additional pool within the boundaries of the attraction.

WATER SLIDES. A water recreation attraction ride that is characterized by having trough-like or tubular flumes or chutes.

WATER THEME PARK. A complex with controlled access, fenced and gated attractions where guests enter through a limited number of entrances upon purchase of a ticket. These facilities are permanent and consist of multiple water recreation attractions. Lifeguards are present during all operating hours.

WATER THERAPY FACILITIES. As used in Section 514.0115(1), F.S., are pools used exclusively for water therapy to treat a diagnosed injury, illness or medical condition, wherein the therapy is provided under the direct supervision of a Florida-licensed physical therapist, occupational therapist or athletic trainer; pursuant to a prescription by a physician or a physician’s assistant (PA) licensed pursuant to Chapters 458 or 459, F.S., a podiatrist licensed pursuant to Chapter 461, F.S., or an advanced registered nurse practitioner (ARNP) licensed pursuant to Chapter 464, F.S.; and the prescribing physician, PA, podiatrist or ARNP, authorizes a plan of treatment justifying use of the pool for health care purposes.

WAVE POOL. A water recreation attraction that is characterized by wave action.

WET DECK AREA. The 4-foot-wide, unobstructed pool deck area around the outside of the pool water perimeter, curb, ladders, handrails, diving boards, diving towers, or pool slides, waterfalls, water features, starting blocks, planters or lifeguard chairs.

WIDTH AND/OR LENGTH. Actual water dimension taken from wall to wall at the maximum operating water level.

ZERO DEPTH ENTRY POOL. A pool where the pool floor continues to slope upward to a point where it meets the surface of the water and the pool deck.

R-101.3 General. This Appendix prescribes minimum design, construction, and operation requirements.

R-101.3.1 Where adequate standards do not exist and these rules do not provide sufficient guidance for consideration of innovations in design, construction, and operation of proposed swimming pools or water recreation attractions, the department will establish requirements necessary to protect the health and safety of the pool patrons.

R-101.3.2 All pools that do not meet the definition of private pools are public pools.

R-101.3.3 The Americans with Disabilities Act of 1990 may relate to public pools and should be reviewed by the design engineer and the pool owner.

R-101.3.4 Sizing. The bathing load for conventional swimming pools, wading pools, interactive water features, water activity pools less than 24 inches deep, and special-purpose pools shall be computed on the basis of one person per 5 gpm of recirculation flow. The bathing load for spa-type pools shall be based on one person per each 10 square feet of surface area. The filtration system for swimming pools shall be capable of meeting all other requirements of these rules while providing a flowrate of at least 1 gpm for each living unit at transient facilities and $\frac{3}{4}$ gpm at nontransient facilities. Recreational vehicle sites, campsites and boat slips designated for live-aboards shall be considered a transient living unit. For properties with multiple pools, this requirement includes the cumulative total gpm of all swimming pools, excluding spas, wading pools and interactive water features. All other types of projects shall be sized according to the anticipated bathing load and proposed uses. For the purpose of determining minimum pool size only, the pool turnover period used cannot be less than 3 hours.

SECTION R-102 SWIMMING POOL CONSTRUCTION STANDARDS

R-102.1 Standards. The design, equipment, operation installation, new construction and rehabilitation of pools shall be in accordance with the following standards:

- (a) ANSI/NSPI-1, *Standard for Public Swimming Pools*, 2003
- (b) ANSI/NSPI-2, *Standard for Public Spas*, 1999
- (c) ANSI/APSP-7, *Standard for Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs and Catch Basins*, 2006

R-102.2 Pool structure. Pools shall be constructed of concrete or other impervious and structurally rigid material. All pools shall be water tight, free from structural cracks and shall have a nontoxic, smooth and slip-resistant finish. All materials shall be installed in accordance with manufacturer's specifications unless such specifications violate Chapter 64E-9, (F.A.C.), rule requirements or the approval criteria of NSF/ANSI Standard 50-2007 or NSF/ANSI Standard 60-2005.

- (a) Floors and walls shall be white or pastel in color and shall have the characteristics of reflecting rather than absorbing light. Tile used in less than 5 feet of water must be slip resistant. A minimum 4-inch tile line, each a minimum size of 1 inch on all sides shall be installed at the water line, but shall not exceed 12 inches in height if a dark color is used. Gutter-type pools may substitute 2-inch tile, each a minimum size of 1 inch on all sides, along the pool wall edge of the gutter lip.
- (b) One-inch square tile may be used if the licensed contractor provides a signed written certification to the approving department engineer that the adhesive used on the 1-inch square tile has a manufacturer's tested shear strength of at least 250 pounds per square inch (psi) and the manufacturer has specified the adhesive for use underwater to adhere the type of tile used [vit-

reous (glass) or ceramic]. Tiles shall not have sharp edges exposed that could cause bather injury.

R-102.3 Dimensions.

R-102.3.1 Dimensional standards. Dimensional standards for competition-type pools shall be those published by the National Collegiate Athletic Association, 1998; Federation Internationale de Natation Amateur (FINA), 1998-2000 Handbook; 1998-1999 Official Rules of Diving & Code Regulation of United States Diving Inc.; 1998 United States Swimming Rules and Regulations; and National Federation of State High School Associations, 1997-1998, which are incorporated by reference in this Code.

R-102.3.2 Walls and corners. All pool walls shall have a clearance of 15 feet perpendicular to the wall (as measured at design water level from gutter lip to gutter lip, or on skimmer pools, from vertical wall to vertical wall). Offset steps, spa coves, spa pools and wading pools, are exempt from this clearance requirement. Where interior steps protrude into the pool resulting in less than 15 feet of clearance from any wall, such protrusion shall not exceed 6 feet on any perpendicular line from a tangent to any pool wall from which the steps emanate. The upper part of pool walls in areas 5 feet deep or less shall be within 5 degrees vertical for a minimum depth of $2\frac{1}{2}$ feet from which point the wall may join the floor with a maximum radius equal to the difference between the pool depth and $2\frac{1}{2}$ feet. The upper part of pool walls in areas more than 5 feet deep shall be within 5 degrees vertical for a minimum depth equal to the pool water depth minus $2\frac{1}{2}$ feet from which point the wall may join the floor with a maximum radius of $2\frac{1}{2}$ feet. Corners shall be a minimum 90-degree angle. The corner intersections of walls that protrude or angle into the pool water area shall be rounded with a minimum radius of 2 inches. This radius shall be continued through the top of the gutter edge; chamfering is allowed. Pool coping shall not overhang into the pool more than $1\frac{1}{2}$ inches.

R-102.3.3 Pool floor slope and slope transition. The radius of curvature between the floor and walls is excluded from these requirements. Multiple floor levels in pools are prohibited.

R-102.3.3.1 Floor slope shall be uniform. The floor slope shall be a maximum one unit vertical in 10 units horizontal and a minimum of one unit vertical in 40 units horizontal in areas 5 feet deep or less. The floor slope shall be a maximum one unit vertical in three units horizontal in areas more than 5 feet deep.

R-102.3.3.2 Any transition in floor slope shall occur at a minimum of 5 feet of water depth. A slope transition must have a 2- to 6-inch-wide dark contrasting tile marking across the bottom and must extend up both sides of the pool at the transition point. The marking shall be continuous, except for recessed grouting. A slope transition must have a safety line mounted by use of recessed cup anchors, 2 feet before the contrasting marking, towards the shallow end. The safety line shall have visible floats at maximum 7 feet intervals.

R-102.3.4 Pool depths. The minimum water depth shall be 3 feet in shallow areas and 4 feet in deep areas.

R-102.4 Markings.

R-102.4.1 Depths and markings. Depth and markings shall meet the following criteria:

- (a) The minimum water depth shall be 3 feet in shallow areas and 4 feet in deep areas.
- (b) Permanent depth markings followed by the appropriate full or abbreviated words “FEET,” “FT” or “INCHES,” “IN” shall be installed in minimum 4-inch-high numbers and letters on a contrasting background. Depth markers shall indicate the actual pool depth, within 3 inches, at normal operating water level when measured 3 feet from the pool wall. Symmetrical pool designs with the deep point at the center may be allowed provided a dual marking system is used that indicates the depth at the wall and at the deep point.
- (c) At a minimum, the markings shall be located on both sides of the pool at the shallow end, slope break, deep-end wall and deep point (if located more than 5 feet from the deep-end wall). Depth markings shall be legible from inside the pool and also from the pool deck. The maximum perimeter distance between depth markings is 25 feet. Pool size and geometry may necessitate additional depth marking placements about all sides of the pool to meet this requirement.
- (d) When a curb is provided, the depth markings shall be installed on the inside and outside or top of the pool curb. When a pool curb is not provided, the depth markings shall be located on the inside vertical wall at or above the water level and on the edge of the deck within 2 feet of the pool water. When open-type gutter designs are utilized, depth markers shall be located on the back of the gutter wall.
- (e) When deck-level perimeter overflow systems are utilized, additional depth marking signs shall be posted nearby or placed on adjacent fencing or walls, and the size shall be increased so they are recognizable from inside the swimming pool. Alternatively, tile depth markers may be placed at the top of the pool wall just under the water level. Depth markers placed on the pool deck shall be within 3 feet of the water.
- (f) Those areas of the pool that are not part of an approved diving bowl shall have dark contrasting tile, 4-inch-high “NO DIVING” markings installed along the perimeter of the pool on the top of the pool curb or deck within 2 feet of the pool water with a maximum perimeter distance of 25 feet between markings. A 6-inch tile with a 4-inch or larger red, international “NO DIVING” symbol may be substituted for the “NO DIVING” markings.
- (g) All markings shall be tile, except that pools constructed of fiberglass, thermoplastic or stainless steel may substitute other type markings when it

can be shown that said markings are permanent and will not fade over time. This exemption does not extend to concrete pools that are coated with fiberglass. Tile alternative examples include stone or manufactured plaques with engraved or sandblasted numbers and characters with permanent paint. Permanent appliques may be used for fiberglass, thermoplastic or stainless steel pools. All markings installed on horizontal surfaces shall have a slip-resistant finish. Markings shall be flush with the surrounding area where placed and recessed, if necessary, to provide a smooth finish that will avoid creation of an injury hazard to bathers. Pools that are not conducive to tile can employ other equivalent markings as previously stated.

R-102.4.2 Designs or logos. Any design or logo on the pool floor or walls shall be such that it will not hinder the detection of a human in distress, algae, sediment or other objects in the pool, and written approval must be obtained from the department prior to installation.

R-102.4.3 Lane markings. Pools that are not intended to be utilized for officially sanctioned competition may install lap lane markings provided they meet the following criteria: The markings must be 2 to 6 inches wide; they must terminate 5 feet from the end wall in a “T” with the “T” bar at least 18 inches long; they must be placed at 7-foot intervals on center; and be no closer than 4 feet from any sidewall, steps or other obstructions. Floating rope lines associated with lap lanes must not obstruct the entrance or exit from the pool and are prohibited when the pool is open for general use.

R-102.4.4 Targets. Pools that are not intended for officially sanctioned competition may have a 2- to 6-inch- wide, 18-inch by 18-inch target (+) installed on the pool wall.

R-102.5 Color. Pool floors and walls shall be white or light pastel in color and shall have the characteristic of reflecting rather than absorbing light.

Exception: A dark color may be used if (1) a tile line (minimum 4 inches, maximum 12 inches) is installed at the water line or (2) if 2-inch tile is installed along the pool wall edge of the gutter lip for gutter-type pools.

R-102.6 Access. All pools shall have a means of access every 75 feet of pool perimeter with a minimum of two, located so as to serve both ends of the pool. In addition, an access point shall be provided at the deep portion, if the deep portion is not at one end of the pool. When the deep portion of the pool is more than 30 feet wide, both sides of this area shall have a means of access. Access shall consist of ladders, stairs, recessed treads or swimouts, and may be used in combination. All treads shall have a slip-resistant surface.

R-102.6.1 Ladders. Ladders shall be of the cross-braced type, constructed of corrosion-resistant materials and securely anchored into the pool deck. Clearance between the ladder and pool wall shall be between 3 to 6 inches. Ladders shall extend at least 28 inches and not more than 40 inches above the pool deck. Ladder bottom braces shall have intact end caps or bumpers that rest firmly against the pool wall. The top rung of the ladder shall be at or below

the water level on open gutter pools and not more than 12 inches below the deck or curb top on all other type pools.

R-102.6.2 Recessed treads. Recessed treads shall be installed flush with the wall and shall be a minimum 5 inches wide, 10 inches long, with a maximum vertical distance of 12 inches between treads.

R-102.6.3 Stairs. Stairs shall have a minimum tread width of 10 inches and a maximum width of 48 inches for a minimum tread length of 24 inches and a maximum riser height of 10 inches. Treads and risers between the top and bottom treads shall be uniform to within $\frac{1}{2}$ inch in width and height. The riser heights shall be measured at the marked step edges and the differences in elevation shall be considered the riser heights. The front $\frac{3}{4}$ to 2 inches of the tread and the top 2 inches of the riser shall be tile, dark in color, contrasting with the interior of the pool. Tile shall be slip resistant. Bullnose tile that is slip resistant may be used when the $\frac{3}{4}$ -inch segment is placed on the tread or horizontal surface and the 2-inch segment is placed on the riser or vertical surface. Where the gutter is used as the top step, the tile on the gutter for the width of the steps shall be slip resistant. Vinyl liner and fiberglass pools may use other material for the step edge marking, provided the material is permanent, permanently secured, dark in color, nonfading and slip resistant.

R-102.6.4 Swimouts. Swimouts shall extend 18 to 24 inches back from the pool wall, shall be 4 to 5 feet wide; a maximum of 12 inches below the deck, unless stairs are provided in the swimout; and located only in areas of the pool greater than 5 feet deep. Pools that do not utilize a continuous perimeter overflow system must provide a wall return inlet in the swimout for circulation. A permanent, dark, contrasting colored band of tile shall be installed at the intersection of the pool wall and the swimout, and must extend 2 inches on the horizontal and vertical surfaces. Tile must be slip resistant. Bullnose tile may be substituted and installed in accordance with Subsection R-102.6.3.

R-102.6.5 Handrails and grabrails. Handrails shall be provided for all stairs, and shall be anchored in the bottom step and the deck. Where “figure 4” deck-mounted-type handrails are used, they shall be anchored in the deck and extend laterally to any point vertically above the bottom step. Grabrails must be mounted in the pool deck at each side of recessed steps. Handrails and grabrails shall extend between 28 and 40 inches above the step edge and deck.

R-102.6.6 Disabled access. Permanent or portable steps, ramps, handrails, lifts or other devices designed to accommodate disabled individuals in swimming pools may be provided. Lifts mounted into the pool deck shall have a minimum 4-foot-wide deck behind the lift mount.

R-102.7 Obstructions. The pool water area shall be unobstructed by any type structure unless justified by engineering design as a part of the recirculation system. Engineering design and material specifications shall show that such structures will not endanger the pool patron, can be maintained in a sanitary condition, and will not create a problem for sani-

tary maintenance of any part of the pool, pool water or pool facilities. Structures in accordance with this Subsection shall not be located in a diving bowl area or within 15 feet of any pool wall.

Exceptions:

1. Stairs, ladders and ramps, necessary for entrance/exit from the pool are not considered obstructions.
2. Underwater seat benches may be installed in areas less than 5 feet deep. Bench seats must be 14 to 18 inches wide and must have a dark contrasting tile marking on the seat edge extending 2 inches on the horizontal and vertical surface. Tile shall be slip resistant. Bullnose tile may be substituted and installed in accordance with Subsection R-102.6.3. Vinyl liner, stainless steel and fiberglass pools may use other material for the bench-edge marking as detailed in Subsection R-102.4.1(g), provided the material is permanently secured, dark in color, nonfading and slip resistant. Benches shall not protrude into the 15-foot clearance requirement of this Subsection.

R-102.8 Diving areas. Diving facilities shall meet the minimum requirements of the FINA dimensions for diving facilities in accordance with the 2005-2009 FINA Handbook and include the following:

- (a) Diving boards or platforms with heights of less than the established standard shall meet the dimensional requirements of the next greater height.
- (b) Diving boards, platforms and ladders shall have a non-absorbent, slip-resistant finish and be of sufficient strength to safely carry the anticipated loads. Diving equipment 1 meter and greater shall have guardrails, which extend to the edge of the pool wall. All diving boards more than 21 inches from the deck shall be provided with a ladder. Diving boards or platforms shall not be installed on curved walls where the wall enters into the defined rectangular diving area specified in this Subsection. Adjacent platform and diving boards shall be parallel.
- (c) The location of pool ladders shall be such that the distance from the ladder to any point on a diving board or platform centerline is not less than the plummet to sidewall dimension (b) indicated in the FINA standards. Trampoline-type diving facilities are prohibited.
- (d) Diving targets may be installed in accordance with FINA standards.

SECTION R-103 POOL APPURTENANCES

R-103.1 Decks and walkways.

R-103.1.1 Pool wet decks shall be constructed of concrete or other nonabsorbent material having a smooth, slip-resistant finish. Wet deck area finishes shall be designed for such use and shall be installed in accordance with the manufacturer’s specifications. Wooden decks and walkways are prohibited.

R-103.1.2 Pool wet decks shall be uniformly sloped at a minimum of 2 percent to a maximum of 4 percent away from the pool or to deck drains to prevent standing water. Textured deck finishes that provide pitting and crevices of more than $\frac{3}{16}$ -inch deep that accumulate soil are prohibited. If settling or weathering occurs that would cause standing water, the original slopes shall be restored or corrective drains installed. When a curb is provided, the deck shall not be more than 10 inches below the top of the curb.

R-103.1.3 Pool wet decks shall have a minimum unobstructed width of 4 feet around the perimeter of the pool, pool curb, ladders, handrails, diving boards, diving towers and slides.

R-103.1.4 Traffic barriers shall be provided, as needed, so that parked vehicles do not extend over the deck area.

R-103.1.5 Walkways shall be provided between the pool and sanitary facilities, and shall be constructed of concrete or other nonabsorbent material having a smooth, slip-resistant finish for the first 15 feet of the walkway measured from the nearest pool water's edge. A hose bibb with a vacuum breaker shall be provided to allow the deck to be washed down with potable water.

R-103.1.6 Ten percent of the deck along the pool perimeter may be obstructed. Obstructions shall have a wet deck area behind or through them, with the near edge of the walkways within 15 feet of the water, except approved slide obstructions shall have the near edge of the walkways within 35 feet of the water. These obstructions must be protected by a barrier or must be designed to discourage patron access. When an obstruction exists in multiple areas around the pool, the minimum distance between obstructions shall be 4 feet.

R-103.1.7 Food or drink service facilities shall not be located within 12 feet of the water's edge.

R-103.1.8 The vertical clearance above the pool deck shall be at least 7 feet.

R-103.1.9 All public pools shall be surrounded by a minimum 48-inch-high fence or other approved substantial barrier. The fence shall be continuous around the perimeter of the pool area that is not otherwise blocked or obstructed by adjacent buildings or structures, and shall adjoin with itself or abut to the adjacent members. Access through the barrier or fence shall be through self-closing, self-latching lockable gates of 48-inch minimal height from the floor or ground with the latch located a minimum of 54 inches from the bottom of the gate or at least 3 inches below the top of the gate on the pool side. Doors opening into the pool area from dwelling units, such as homes, apartments, hotel rooms and motel rooms, shall be self-closing and self-latching. If the self-closing, self-latching gate is also self-locking and is operated by a key lock, electronic opener or integral combination lock, then the operable parts of such locks or openers shall be 34 inches minimum and 48 inches maximum above the finished floor or ground. Gates shall open outward away from the pool area. A latched, lockable gate shall be placed in the fence within 10 feet of the closest point

between the pool and the equipment area for service access.

Instead of a fence, permanent, natural or man-made features, such as bulkheads, canals, lakes, navigable waterways, etc., adjacent to a pool may be permitted as a barrier when approved. When evaluating such barrier features, the applicable governing body may perform onsite inspections, and review evidence, such as surveys, aerial photographs, water management agency standards and specifications, and any other similar documentation to verify, at minimum, the following: The barrier feature is not subject to natural changes, deviations or alterations, and is capable of providing an equivalent level of protection as that provided by a structure, and the barrier feature clearly impedes, prohibits or restricts access to the pool.

Screened pool enclosures shall be provided with solid surfaces or have framing members spaced so that a 4-inch sphere can not pass on the bottom 3 feet to be considered a barrier. Safety covers shall not satisfy this requirement.

R-103.1.9.1 Barriers.

R-103.1.9.1.1 Outdoor swimming pools. Outdoor swimming pools shall be provided with a barrier complying with Subsections R-103.1.9.1.1.1 through R-103.1.9.1.1.8.

Exception: Water recreation attractions and specialized pools.

R-103.1.9.1.1.1 The top of the barrier shall be at least 48 inches above grade measured on the side of the barrier that faces away from the swimming pool. The maximum vertical clearance between grade and the bottom of the barrier shall be 2 inches measured on the side of the barrier that faces away from the swimming pool. Where the top of the pool structure is above grade, the barrier may be at ground level or mounted on top of the pool structure. Where the barrier is mounted on top of the pool structure, the maximum vertical clearance between the top of the pool structure and the bottom of the barrier shall be 4 inches.

R-103.1.9.1.1.2 The barrier may not have any gaps, openings, indentations, protrusions or structural components that could allow a young child to crawl under, squeeze through or climb over the barrier as herein described. One end of a removable child barrier shall not be removable without the aid of tools. Openings in any barrier shall not allow passage of a 4-inch-diameter sphere.

R-103.1.9.1.1.3 Solid barriers that do not have openings shall not contain indentations or protrusions, except for normal construction tolerances and tooled masonry joints.

R-103.1.9.1.1.4 Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is less than 45 inches, the horizontal members shall be located on the swimming pool side of the

fence. Spacing between vertical members shall not exceed $1\frac{3}{4}$ inches in width. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed $1\frac{3}{4}$ inches in width.

R-103.1.9.1.1.5 Where the barrier is composed of horizontal and vertical members, and the distance between the tops of the horizontal members is 45 inches or more, spacing between vertical members shall not exceed 4 inches. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed $1\frac{3}{4}$ inches in width.

R-103.1.9.1.1.6 Maximum mesh size for chain link fences shall be a $2\frac{1}{4}$ -inch square unless the fence is provided with slats fastened at the top or bottom that reduce the openings to no more than $1\frac{3}{4}$ inches.

R-103.1.9.1.1.7 Where the barrier is composed of diagonal members, the maximum opening formed by the diagonal members shall be no more than $1\frac{3}{4}$ inches.

R-103.1.9.1.1.8 Access gates, when provided, shall be self-closing, shall comply with the requirements of Subsections R-103.1.9.1.1.1 through R-103.1.9.1.1.7 and shall be equipped with a self-latching locking device located on the pool side of the gate. Where the operable part of the latch device release is located no less than 54 inches above the latch-side deck surface, the device release mechanism may be located on either side of the gate and so placed that it cannot be reached by a young child over the top or through any opening or gap from the outside. Gates that provide access to the swimming pool must open outward away from the pool. The gates and barrier shall have no opening greater than $\frac{1}{2}$ inch within 18 inches of the release mechanism.

Exception: If the self-closing, self-latching gate is also self-locking and is operated by a key lock, electronic opener or integral combination lock, then the operable parts of such locks or openers shall be 34 inches minimum and 48 inches maximum above the finish floor or ground.

R-103.2 Bridges and overhead obstructions. Bridges and overhead obstructions over the pool shall be designed so they will not introduce any contamination to the pool water. The minimum height of the bridge or obstruction shall be at least 8 feet from the bottom of the pool and at least 4 feet above the surface of the pool. Minimum 42-inch-high handrails shall be provided along each side of the bridge. The walking surfaces shall be constructed of concrete or other nonabsorbent mate-

rial having a smooth, slip-resistant finish. Pool coping shall not overhang into the pool more than $1\frac{1}{2}$ inches.

SECTION R-104 ELECTRICAL SYSTEMS

R-104.1 Electrical equipment and wiring. Electrical equipment wiring and installation, including the grounding of pool components, shall conform with the *National Electrical Code*.

R-104.2 Lighting. Artificial lighting shall be provided at all swimming pools, which are to be used at night or which do not have adequate natural lighting, so that all portions of the pool, including the bottom, may be readily seen without glare.

R-104.2.1 Outdoor pool lighting. Lighting shall provide a minimum of 3 footcandles of illumination at the pool water surface and the pool wet deck surface. Underwater lighting shall be a minimum of $\frac{1}{2}$ watt per square foot of pool water surface area.

R-104.2.2 Indoor pool lighting. Lighting shall provide a minimum of 10 footcandles of illumination at the pool water surface and the pool wet deck surface. Underwater lighting shall be a minimum of $\frac{8}{10}$ watt per square foot of pool surface area.

R-104.2.3 Underwater lighting. Underwater lighting shall utilize transformers and low-voltage circuits with each underwater light being grounded. The maximum voltage for each light shall be 15 volts and the maximum incandescent lamp size shall be 300 watts. The location of the underwater lights shall be such that the underwater illumination is as uniform as possible and shall not be less than 18 inches below the normal operating water level determined by the centerline of the skimmer or top lip of the gutter. All underwater lights, which depend upon submersion for safe operation, shall have protection from overheating when not submerged. Underwater lighting requirements can be waived when the overhead lighting provides at least 15 footcandles of illumination at the pool water surface and pool wet deck surface. Alternative lighting systems that use 15 volts or less, or use no electricity in the pool or on the pool deck, such as light emitting diode (LED) or fiber optic systems, may be utilized if the applicant demonstrates to reasonable certainty that the system development has advanced to the point where the department is convinced that the pool illumination is equal to the requirements in Subsections R-104.2.1 and R-104.2.2.

R-104.2.4 Overhead wiring. Overhead service wiring shall not pass within an area extending a distance of 10 feet horizontally away from the inside edge of the pool walls, diving structures, observation stands, towers or platforms. Allowances for overhead conductor clearances to pools that meet the safety standards in the NEC may be used instead. Electrical equipment wiring and installation included in the grounding of pool components shall comply with the NEC.

SECTION R-105 EQUIPMENT AREA OR ROOMS

R-105.1 Outdoor equipment. Equipment designated by the manufacturer for outdoor use may be located in an equipment area; all other equipment must be located in an equipment room or enclosure. Plastic pipe subject to a period of prolonged sunlight exposure must be coated to protect it from ultraviolet-light (UV) degradation. An equipment area shall be surrounded with a fence at least 4 feet high on all sides not confined by a building or equivalent structure. A self-closing and self-latching gate with a permanent locking device shall be provided if necessary for access. An equipment room shall be protected on at least three sides and overhead. Any fence or gate installed shall use members spacing that shall not allow passage of a 4-inch-diameter sphere. The fourth side may be a gate, fence or open if otherwise protected from unauthorized entrance. An equipment enclosure shall be lockable or otherwise protected from unauthorized access.

R-105.2 Indoor equipment. Equipment not designated by the manufacturer for outdoor use shall be located in an equipment room. An equipment room shall be protected on at least three sides and overhead. The fourth side may be a gate, fence or open if otherwise protected from unauthorized entrance.

R-105.3 Materials. The equipment enclosure, area or room floor shall be of concrete or other nonabsorbent material having a smooth, slip-resistant finish, and shall have positive drainage, including a sump pump if necessary. Ancillary equipment, such as a heater, not contained in an equipment enclosure or room, shall necessitate an equipment area as previously described.

R-105.4 Ventilation. Equipment rooms shall have either forced draft or cross ventilation. All below-grade equipment rooms shall have a stairway access with forced draft ventilation or a fully louvered door and powered intake within 6 inches of the floor. Where stairway access is not necessary to carry heavy items into the below-grade room or vault, a “ship’s ladder” may be used, if specified by the design engineer who must consider anticipated workload, including equipment removal; the ladder slope, tread height and width; and construction material of the ladder.

R-105.5 Access. The opening to equipment room or area shall be a minimum 3 feet by 6 feet and shall provide easy access to the equipment.

R-105.6 Size. The size of the equipment enclosure, room or area shall provide working space to perform routine operations. Clearance shall be provided for all equipment as prescribed by the manufacturer to allow normal maintenance operation and removal without disturbing other piping or equipment. In rooms with fixed ceilings, the minimum height shall be 7 feet.

R-105.7 Lighting. Equipment rooms or areas shall be lighted to provide 30 footcandles of illumination at floor level.

R-105.8 Storage. Equipment enclosures, rooms or areas shall not be used for storage of chemicals emitting corrosive fumes or for storage of other items to the extent that entrance to the room for inspection or operation of the equipment is impaired.

R-105.9 Hose bibbs. A hose bibb with vacuum breaker shall be located in the equipment room or area.

SECTION R-106 PLUMBING SYSTEMS

R-106.1 Sanitary facilities. Swimming pools with a bathing load of 20 persons or less may utilize a unisex restroom. Pools with bathing loads of 40 persons or less may utilize two unisex restrooms or meet the requirements of Table R-106.1. Unisex restrooms shall meet all the requirements for materials, drainage and signage as indicated in Subsections R-106.1.1 through R-106.1.4. Each shall include a water closet, diaper changing table, urinal and lavatory. Pools with a bathing load larger than 40 persons shall provide separate sanitary facilities labeled for each sex. The entry doors of all restrooms shall be located within a 200-foot walking distance of the nearest water’s edge of each pool served by the facilities.

Exception: Where a swimming pool serves only a designated group of residential dwelling units and not the general public, pool-side sanitary facilities are not required if all living units are within a 200-foot horizontal radius of the nearest water’s edge, are not more than three stories in height unless serviced by an elevator, and are each equipped with private sanitary facilities.

R-106.1.1 Required fixtures. Fixtures shall be provided as indicated in Table R-106.1. The fixture count in this Table is deemed to be adequate for the pool and pool deck area that is up to three times the area of the pool surface provided.

When multiple fixture sets are required and separate facilities are provided for each sex, the fixtures used in ancillary family-style restrooms can be used to meet the requirements of this Subsection.

One diaper changing table shall be provided at each restroom. Diaper changing tables are not required at restrooms where all pools served are restricted to adult use only. Swim diapers are recommended for use by children that are not toilet trained. Persons that are ill with diarrhea can not enter the pool.

**TABLE R-106.1
PUBLIC SWIMMING POOL—REQUIRED FIXTURE COUNT**

MEN'S RESTROOM			
SIZE OF POOL	URINALS	WC	LAVATORY
0 – 2,500 square feet	1	1	1
2,501 – 5,000 square feet	2	1	1
5,001 – 7,500 square feet	2	2	2
7,501 – 10,000 square feet	3	2	3
WOMEN'S RESTROOM			
SIZE OF POOL	URINALS	WC	LAVATORY
0 – 2,500 square feet	0	1	1
2,501 – 5,000 square feet	0	5	1
5,001 – 7,500 square feet	0	6	2
7,501 – 10,000 square feet	0	8	3

Note: An additional set of fixtures shall be provided in the men’s restroom for every 7,500 square feet or major fraction thereof for pools greater than 10,000 square feet. Women’s restrooms shall have a ratio of three to two water closets provided for women as the combined total of water closets and urinals provided for men. Lavatory counts shall be equal.

R-106.1.2 Outside access to facilities shall be provided for bathers at outdoor pools. Where the restrooms are located within an adjacent building and the restroom doors do not open to the outside, the restroom doors shall be within 50 feet of the buildings exterior door. If the restrooms are not visible from any portion of the pool deck, signs shall be posted showing directions to the facilities. Directions shall be legible from any portion of the pool deck; letters shall be a minimum of 1 inch high.

R-106.1.3 Sanitary facility floors. Floors of sanitary facilities shall be constructed of concrete or other non-absorbent materials; shall have a smooth, slip-resistant finish; and shall slope to floor drains. Carpets, duckboards and footbaths are prohibited. The intersection between the floor and walls shall be covered where either floor or wall is not made of waterproof materials, such as tile or vinyl.

R-106.1.4 Hose bibb. A hose bibb with vacuum breaker shall be provided in or within 25 feet of each restroom to allow for ease of cleaning.

R-106.2 Rinse shower. A minimum of one rinse shower shall be provided on the pool deck of all outdoor pools within 20 feet of the nearest pool water's edge.

R-106.3 Cross-connection prevention. An atmospheric break or approved backflow prevention device shall be provided in each pool water supply line that is connected to a public water supply. Vacuum breakers shall be installed on all hose bibbs.

R-106.4 Plastic pipes. Plastic pipe subject to a period of prolonged sunlight exposure shall be coated to protect it from UV light degradation.

R-106.5 Recirculation and treatment systems.

R-106.5.1 Equipment testing. Recirculation and treatment equipment, such as filters, recessed automatic surface skimmers, ionizers, ozone generators, disinfection feeders and chlorine generators, shall be tested and approved using ANSI Standard 50-2007, which is incorporated by reference. If standards do not exist for a specific product, the manufacturer must work with the National Sanitation Foundation (NSF) or other American National Standards Institute-approved (ANSI) agencies to develop such standards.

R-106.5.2 Volume. The recirculation system shall be designed to provide a minimum of four turnovers of the pool volume per day. Pools that are less than 1,000 square feet at health clubs shall be required to provide eight turnovers per day.

R-106.5.3 System design. The design pattern of recirculation flow shall be 100 percent through the main drain piping and 100 percent through the perimeter overflow system or 60 percent through the skimmer system.

R-106.5.3.1 Perimeter overflow gutters. The lip of the gutter shall be uniformly level with a maximum tolerance of $\frac{1}{4}$ inch between the high and low areas. The bottom of the gutter shall be level or slope to the drains. The spacing between drains shall not exceed 10 feet for 2-inch drains or 15 feet for $2\frac{1}{2}$ -inch drains, unless

hydraulically justified by the design engineer. Gutters may be eliminated along pool edges for no more than 15 feet and this shall not exceed 10 percent of the perimeter (at least 90 percent of the perimeter shall be guttered). In areas where gutters are eliminated, handholds shall be provided within 9 inches of the water surface. Handhold design shall be approved by the department prior to construction.

R-106.5.3.1.1 Either recessed-type or open-type gutters shall be used. Special designs can be approved provided they are within limits of sound engineering practice. Recessed-type gutters shall be at least 4 inches deep and 4 inches wide. No part of the recessed gutter shall be visible from a position directly above the gutter sighting vertically down the edge of the deck or curb. Open-type gutters shall be at least 6 inches deep and 12 inches wide. The gutter shall slope 2 inches, $\pm\frac{1}{4}$ inch, from the lip to the drains. The gutter drains shall be located at the deepest part of the gutter.

R-106.5.3.1.2 All gutter systems shall discharge into a collector tank.

R-106.5.3.1.3 The gutter lip shall be tiled with a minimum of 2-inch tile on the pool wall, each a minimum size of 1 inch on all sides. The back vertical wall of the gutter shall be tiled with glazed tile.

Exception: Stainless steel gutter systems when it can be shown that the surfaces at the waterline and back of the gutter are easily cleanable.

R-106.5.3.2 Recessed automatic surface skimmers. Recessed automatic surface skimmers may be utilized when the pool water surface area is 1,000 square feet or less excluding offset stairs and swimouts, and the width of the pool is not more than 20 feet.

R-106.5.3.2.1 Volume. The recessed automatic surface skimmer piping system shall be designed to carry 60 percent of the pool total design flow rate with each skimmer carrying a minimum 30 gpm. One skimmer for every 400 square feet or fraction thereof of pool water surface area shall be provided.

R-106.5.3.2.2 Location. Prevailing wind direction and the pool outline shall be considered by the designer in the selection of skimmer locations. The location of skimmers shall be such that the interference of adjacent inlets and skimmers is minimized. Recessed automatic surface skimmers shall be installed so that there is no protrusion into the pool water area. The deck or curb shall provide for a handhold around the entire pool perimeter and shall not be located more than 9 inches above the mid point of the opening of the skimmer.

R-106.5.3.2.3 Equalizers. Recessed automatic surface skimmers shall be installed with an equalizer valve and an equalizer line when the skimmer piping system is connected directly to pump suction. If installed, the equalizer valve shall be a spring-loaded vertical check valve that will not allow direct

suction on the equalizer line. Float valves are prohibited. The equalizer line inlet shall be installed at least 1 foot below the normal pool water level and the equalizer line inlet shall be protected by an ASME/ANSI A112.19.8 compliant cover/grate. The equalizer line shall be sized to handle the expected flow with a 2-inch minimum line size.

R-106.5.3.2.4 Wall-inlet fitting. A wall-inlet fitting shall be provided directly across from each skimmer.

R-106.5.3.2.5 Waterline tile. A minimum 6-inch waterline tile shall be provided on all pools with automatic skimmer systems, each a minimum size of 1 inch on all sides. Glazed tile that is smooth and easily cleanable shall be utilized.

R-106.5.4 Pumps. If the pump or suction piping is located above the water level of the pool, the pump shall be self-priming. Pumps that take suction prior to filtration shall be equipped with a hair and lint strainer. The recirculation pump shall be selected to provide the required recirculation flow against a minimum total dynamic head of 60 feet unless hydraulically justified by the design engineer. Vacuum D.E. filter system pumps shall provide at least 50 feet of total dynamic head. Should the total dynamic head required not be appropriate for a given project, the design engineer shall provide an alternative.

R-106.5.5 Filters. Filters sized to handle the required recirculation flow shall be provided.

R-106.5.5.1 Filter capacities. The maximum filtration rate, in gallons per minute per square foot of filter area, shall be: 15 (20 if so approved using the procedure stated in Subsection R-106.5.2) for high-rate sand filters, 3 for rapid sand filters, 0.075 for pleated cartridge filters and 2 for D.E.-type filters.

R-106.5.5.2 Filter appurtenances.

R-106.5.5.2.1 Pressure filter systems. Pressure filter systems shall be equipped with an air relief valve; influent and effluent pressure gauges with minimum face size of 2 inches reading 0 to 60 psi; and a sight glass when a backwash line is required.

R-106.5.5.2.2 Vacuum filter systems. Vacuum filter systems shall be equipped with a vacuum gauge that has a 2-inch face and reads from 0 to 30 inches of mercury.

R-106.5.5.2.3 D.E. systems. A precoat pot or collector tank shall be provided for D.E. systems.

R-106.5.5.3 Filter tanks and elements. The filter area shall be determined on the basis of effective filtering surfaces with no allowance given for areas of impaired filtration, such as broad supports, folds or portions that may bridge. D.E. filter elements shall have a minimum 1-inch clear spacing between elements up to a 4-square-foot effective area. The spacing between filter elements shall increase $\frac{1}{8}$ inch for each additional square foot of filter area or fraction thereof above an effective filter area of 4 square feet. All cartridges used in public pool filters shall be permanently marked with

the manufacturer's name, pore size and area in square feet of filter material. All cartridges with end caps shall have the permanent markings on one end cap. Vacuum filter tanks shall have covered intersections between the wall and the floor, and the tank floor shall slope to the filter tank drain. The D.E. filter tank and elements shall be installed such that the recirculation flow draw down does not expose the elements to the atmosphere whenever only the main drain valve is open or only the surface overflow gutter system valve is open.

R-106.5.6 Piping. All plastic pipe used in the recirculation system shall be imprinted with the manufacturer's name and the NSF-potable water logo for potable water applications. Size, schedule and type of pipe shall be included on the drawings. Plastic pipe subject to a period of prolonged sunlight exposure shall be coated to protect it from UV light degradation.

R-106.5.7 Valves. Return lines, main drain lines and surface overflow system lines shall each have proportioning valves.

R-106.5.8 Flow velocity. Pressure piping shall not exceed 8 feet per second, except that precoat lines with higher velocities may be used when necessary for agitation purposes. The flow velocity in suction piping shall not exceed 6 feet per second, except that flow velocities up to 10 feet per second in filter assembly headers will be acceptable. Main drain systems and surface overflow systems, which discharge to collector tanks, shall be sized with a maximum flow velocity of 3 feet per second. The filter and vacuuming system shall have the necessary valves and piping to allow filtering to pool, vacuuming to waste, vacuuming to filter, complete drainage of the filter tank, backwashing for sand, and pressure D.E.-type filters and precoat recirculation for D.E.-type filters.

R-106.5.9 Inlets. All inlets shall be adjustable with wall-type inlets being directionally adjustable and floor-type inlets having a means of flow adjustment. Floor inlets shall be designed and installed such that they do not protrude above the pool floor, and all inlets shall be designed and installed so as not to constitute sharp edges or protrusions hazardous to pool bathers. Floor inlets for vinyl liner and fiberglass pools shall be smooth with no sharp edges, and shall not extend more than $\frac{3}{8}$ inches above the pool floor. Wall inlets shall be installed a minimum of 12 inches below the normal operating water level unless precluded by the pool depth or intended for a specific acceptable purpose.

R-106.5.9.1 Pools 30 feet in width or less, with wall inlets only, shall have enough inlets such that the inlet spacing does not exceed 20 feet based on the pool water perimeter.

R-106.5.9.2 Pools 30 feet in width or less, with floor inlets only, shall have a number of inlets provided such that the spacing between adjacent inlets does not exceed 20 feet and the spacing between inlets and adjacent walls does not exceed 10 feet.

R-106.5.9.3 A combination of wall and floor inlets may be used in pools 30 feet in width or less only if require-

ments of Subsection R-106.5.9.1 or R-106.5.9.2 are fully met.

R-106.5.9.4 Pools greater than 30 feet in width shall have either floor inlets only, or a combination of floor inlets and wall inlet. Pools with floor inlets only shall have a number of floor inlets provided such that the spacing between adjacent inlets does not exceed 20 feet, and the spacing between inlets and an adjacent wall does not exceed 10 feet.

R-106.5.9.5 Pools greater than 30 feet in width, with a combination of wall and floor inlets, shall have the number of wall inlets such that the maximum spacing between the wall inlets is 20 feet and floor inlets are provided for the pool water area beyond a 15-foot perpendicular distance from all walls. The number of floor inlets shall be such that the spacing between adjacent inlets does not exceed 20 feet, and the distance from a floor inlet and an adjacent wall does not exceed 25 feet. Floor inlets shall be designed and installed such that they do not protrude more than $\frac{5}{8}$ inch above the pool floor, and all inlets shall be designed and installed so as not to constitute sharp edges or protrusions hazardous to pool bathers.

R-106.5.9.6 The flow rate through each inlet shall not exceed 15 gpm.

R-106.5.10 Main drain outlets. All pools shall be provided with an outlet at the deepest point.

R-106.5.10.1 The depth at the outlet must not deviate more than 3 inches from the sidewall.

R-106.5.10.2 Outlets shall be covered by a secured grating that requires the use of a tool to remove and whose open area is such that the maximum velocity of water passing through the openings does not exceed $1\frac{1}{2}$ feet per second at 100 percent of the design recirculation flow. Main drain covers/grates shall comply with the requirements of ASME/ANSI A112.19.8 and the water velocity of this Subsection.

R-106.5.10.3 Multiple outlets, equally spaced from the pool sidewalls and from each other, shall be installed in pools where the deep portion of the pool is greater than 30 feet in width.

R-106.5.10.4 If the area is subject to high ground water, the pool shall be designed to withstand hydraulic uplift or shall be provided with hydrostatic relief devices.

R-106.5.10.5 The main drain outlet shall be connected to a collector tank. The capacity of the collector tank shall be at least 1 minute of the recirculated flow unless justified by the design engineer. Vacuum filter tanks are considered collector tanks.

R-106.5.11 Water makeup control. An automatic and manual water makeup control shall be provided to maintain the water level at the lip of the overflow gutter or at the mouth of the recessed automatic surface skimmers, and shall discharge through an air gap into a fill pipe or collector tank. Over-the-rim fill spouts are prohibited.

R-106.5.12 Cleaning system. A portable or plumbed-in vacuum cleaning system shall be provided. All vacuum pumps shall be equipped with hair and lint strainers. When the system is plumbed in, the vacuum fittings shall be located to allow cleaning the pool with a 50-foot maximum length of hose. Vacuum fittings shall be mounted approximately 12 inches below the water level, flush with the pool walls, and shall be provided with a spring-loaded safety cover or flush plug cover, which shall be in place at all times when the pool is not being vacuumed. Bag-type cleaners, which operate as ejectors on potable water supply pressure, shall be protected by a vacuum breaker. Cleaning devices shall not be used while the pool is open to bathers.

R-106.5.13 Rate-of-flow indicators. A rate-of-flow indicator, reading in gallons per minute, shall be installed on the return line. The rate-of-flow indicator shall be properly sized for the design flow rate and shall be capable of measuring from one-half to at least $1\frac{1}{2}$ times the design flow rate. The clearances upstream and downstream from the rate-of-flow indicator shall comply with manufacturer's installation specifications.

R-106.5.14 Heaters. Pool heaters shall comply with nationally recognized standards acceptable to the department and to the design engineer. Pools equipped with heaters shall have a fixed thermometer mounted in the pool recirculation line downstream from the heater outlet. Thermometers mounted on heater outlets do not meet this requirement. A sketch of any proposed heater installation, including valves, thermometer, pipe sizes and material specifications, shall be included in the application for permit prior to installation. Piping and influent, effluent and bypass valves, which allow isolation or removal of the heater from the system, shall be provided. Materials used in solar and other heaters shall be nontoxic and acceptable for use with potable water. Heaters shall not prevent the attainment of the required turnover rate.

R-106.5.15 Pool waste water disposal. Pool waste water shall be discharged through an air gap; disposal shall be to sanitary sewers, storm sewers, drain fields or by other means; shall be approved by Reedy Creek Planning and Engineering; and obtain all necessary permits. Disposal of water from pools using D.E. powder shall be accomplished through separation tanks that are equipped with air bleed valves, bottom drain lines and isolation valves, or through a settling tank with final disposal being acceptable to Reedy Creek Planning and Engineering. D.E. separator tanks shall have a capacity, as rated by the manufacturer, equal to the square footage of the filter system. All lines shall be sized to handle the expected flow. There shall not be a direct physical connection between any drain from a pool or recirculation system and a sewer line.

R-106.5.16 Addition of chemicals. Disinfection and pH adjustment shall be added to the pool recirculation flow using automatic feeders meeting the requirement of NSF/ANSI 50. All chemicals shall be fed into the return line after the pump, heater and filters unless the feeder was designed by the manufacturer and approved by the NSF to

feed to the collector tank or to the suction side of the pump.

R-106.5.16.1 Gas chlorination. When gas chlorination is utilized, the chlorinator shall be capable of continuously feeding a chlorine dosage of 6 milligrams per liter (mg/L) to the recirculated flow of the filtration system. The application point for chlorine shall be located in the return line downstream of the filter, recirculation pump, heater and flow meter, and as far as possible from the pool.

R-106.5.16.1.1 Gas chlorinators shall be located in above-grade rooms and in areas that are inaccessible to unauthorized persons.

R-106.5.16.1.1.1 Chlorine rooms shall have: continuous forced draft ventilation capable of a minimum of one air change per minute with an exhaust at floor level to the outside, a minimum of 30 footcandles of illumination with the switch located outside, and the door shall open out and shall not be located adjacent to the filter room entrance or the pool deck. A shatterproof, gas-tight inspection window shall be provided.

R-106.5.16.1.1.2 Chlorine areas shall have a roof and shall be enclosed by a chain-link-type fence at least 6 feet high to allow ventilation and prevent vandalism.

R-106.5.16.1.2 A gas mask or a self-contained breathing apparatus, approved for use in chlorine gas-contaminated air, shall be provided and shall be located out of the area of possible contamination.

R-106.5.16.1.3 When booster pumps are used with the chlorinator, the pump shall use recirculated pool water supplied via the recirculation filtration system. The booster pump shall be electrically interlocked with the recirculation pump to prevent the feeding of chlorine when the recirculation pump is not operating.

R-106.5.16.1.4 A means of weighing chlorine containers shall be provided. When 150-pound cylinders are used, platform-type scales shall be provided and shall be capable of weighing a minimum of two full cylinders at one time. The elevation of the scale platform shall be within 2 inches of the adjacent floor level, and the facilities shall be constructed to allow easy placement of full cylinders on the scales.

R-106.5.16.1.5 Each cylinder shall be secured at all times, with 150-pound cylinders maintained in an upright position. A protective cap shall be in place at all times when the cylinder is not connected to the chlorinator.

R-106.5.16.2 Hypohalogenation and electrolytic chlorine generators. The hypohalogenation-type feeder and electrolytic chlorine generators shall be adjustable from 0 to full range. A rate-of-flow indicator is required on erosion-type feeders. The feeders shall be capable of continuously feeding a dosage of 6 mg/L the minimum required turnover flow rate of the filtration

systems. Solution feeders shall be capable of feeding the dosage using a 10-percent sodium hypochlorite solution or 5-percent calcium hypochlorite solution, whichever disinfectant is to be utilized at this facility. To prevent the disinfectant from siphoning or feeding directly into the pool or pool piping under any type failure of the recirculation equipment, an electrical interlock with the recirculation pump shall be incorporated into the system for electrically operated feeders. The minimum size of the solution reservoirs shall be at least 50 percent of the maximum daily capacity of the feeder. The solution reservoirs shall be marked to indicate contents.

R-106.5.16.3 Feeders for pH adjustment. Feeders for pH adjustment shall be provided on all pools, except spa pools of less than 100 square feet of pool water surface area and pools utilizing erosion-type chlorinators feeding chlorinated isocyanurates. pH adjustment feeders shall be positive displacement type, shall be adjustable from 0 to full range, and shall have an electrical interlock with the circulation pump to prevent discharge when the recirculation pump is not operating. When soda ash is used for pH adjustment, the maximum concentration of soda ash solution to be fed shall not exceed $\frac{1}{2}$ pound soda ash per gallon of water. Feeders for soda ash shall be capable of feeding a minimum of 3 gallons of the above soda ash solution per pound of gas chlorination capacity. The minimum size of the solution reservoirs shall not be less than 50 percent of the maximum daily capacity of the feeder. The solution reservoirs shall be marked to indicate the type of contents.

R-106.5.16.4 Ozone-generating equipment. Ozone-generating equipment may be used for supplemental water treatment on public swimming pools subject to the conditions of this Subsection.

R-106.5.16.4.1 Ozone-generating equipment electrical components and wiring shall comply with the requirements of the NEC and the manufacturer shall provide a Certificate of Conformance. The process equipment shall be provided with an effective means to alert the user when a component of this equipment is not operating.

R-106.5.16.4.2 Ozone-generating equipment shall meet NSF/ANSI 50.

R-106.5.16.4.3 The concentration of ozone in the return line to the pool shall not exceed 0.1 mg/L.

R-106.5.16.4.4 The injection point for ozone-generating equipment shall be located in the pool return line after the filtration and heating equipment, prior to the halogen injection point, and as far as possible from the nearest pool return inlet with a minimum distance of 4 feet. Injection methods shall include a mixer, contact chamber or other means of efficiently mixing the ozone with the recirculated water. The injection and mixing equipment shall not prevent the attainment of the required turnover rate of the recirculation system. Ozone-generating equipment shall be equipped with a check valve between the genera-

tor and the injection point. Ozone-generating equipment shall be equipped with an airflow meter and a means to control the flow.

R-106.5.16.4.5 Ventilation requirements. Ozone-generating equipment shall be installed in equipment rooms with either forced draft or cross draft ventilation. Below-grade equipment rooms with ozone generators shall have forced draft ventilation and all equipment rooms with forced draft ventilation shall have the fan control switch located outside the equipment room door. The exhaust fan intake for forced draft ventilation and at least one vent grille for cross draft ventilation shall be located at floor level.

R-106.5.16.4.6 A self-contained breathing apparatus designed and rated by its manufacturer for use in ozone-contaminated air shall be provided when ozone generator installations are capable of exceeding the maximum pool water ozone contact concentration of 0.1 mg/L. The self-contained breathing apparatus shall be available at all times and shall be used at times when the maintenance or service personnel have determined that the equipment room ozone concentration exceeds 10 mg/L. Ozone generator installations that require the self-contained breathing apparatus shall also be provided with Draeger-type detector tube equipment, which is capable of detecting ozone levels of 10 mg/L.

Exception: In lieu of the self-contained breathing apparatus, an ozone detector capable of detecting 1 mg/L may be used. Said detector shall be capable of stopping the production of ozone, venting the room and sounding an alarm once ozone is detected.

R-106.5.16.5 Ionization units may be used as supplemental water treatment on public pools subject to the conditions of this Subsection.

R-106.5.16.5.1 Ionization equipment and electrical components and wiring shall comply with the requirements of the NEC and the manufacturer shall provide a certification of conformance.

R-106.5.16.5.2 Ionization equipment shall meet NSF/ANSI 50 or equivalent; shall meet UL standards; and shall be electrically interlocked with recirculation pump.

R-106.5.16.6 UV light disinfectant equipment may be used as supplemental water treatment on public pools [and additional treatment on interactive water features (IWF)] subject to the conditions of this Subsection and manufacturer's specifications. UV light is encouraged to be used to eliminate or reduce chlorine-resistant pathogens, especially the protozoan *Cryptosporidium*.

(a) UV equipment and electrical components and wiring shall comply with the requirements of the NEC and the manufacturer shall provide a certification of conformance to the department.

- (b) UV equipment shall meet UL standards, and shall be electrically interlocked with recirculation pump(s) on all pools and with feature pump(s) on an IWF such that when the UV equipment fails to produce the required dosage as measured by an automated sensor, the feature pump(s) are disabled so the water features do not operate.
- (c) UV equipment shall be validated by a capable party that it delivers the required and predicted UV dose at the validated flow, lamp power and water UV transmittance conditions, and has complied with all professional practices summarized in the US Environmental Protection Agency's *Ultraviolet Disinfectant Guidance Manual*, dated November, 2006, which is publication number EPA 815-R-06-007, available from the Florida Department of Health at <http://www.floridashealth.org/Environment/water/swim/index.html> or at http://www.epa.gov/safewater/disinfection/lt2/pdfsguide_lt2_uvguidance.pdf.
- (d) UV equipment shall constantly produce a validated dosage of at least 40 milliJoules per square centimeter at the end of lamp life.
- (e) The UV equipment shall not be located in a side stream flow, and shall be located to treat all water returning to the pool or water features.

SECTION R-107 WADING POOLS

R-107.1 General. Wading pools shall meet the requirements of Subsections R-101.3 through R-106.5, unless otherwise indicated. Wading pools and associated piping shall not be physically connected to any other swimming pools and have no minimum width dimensions requirements.

R-107.2 Depths. Wading pools shall have a maximum depth of 2 feet. The depth at the perimeter of the pool shall be uniform and shall not exceed 12 inches. However, where department-approved zero depth entry designs are used, this uniform depth requirement must be met only on the remainder of the pool outside the zero depth entry portion. The pool floor shall not be more than 12 inches below the deck unless steps and handrails are provided. Depth and "NO DIVING" markers are not required on wading pools.

R-107.3 Recirculation. Wading pools shall have a minimum of one turnover every hour. Lines from main drains shall discharge into a collector tank.

R-107.3.1 Skimmer equalizer lines, when required, shall be plumbed into the main drain installed in the pool floor with a grate covering.

R-107.3.2 The grate cover shall be sized so as not to allow the flow to exceed 1½ feet per second when the equalizer line is operating.

R-107.4 Inlets. Wading pools with 20 feet or less of perimeter shall have a minimum of two, equally spaced adjustable inlets.

R-107.5 Emergency drainage. All wading pools shall have drainage to waste without a cross connection through a quick-opening valve to facilitate emptying the wading pool should accidental bowel or other discharge occur.

R-107.6 Vacuuming. Wading pools with 200 square feet or more of pool water surface area shall have provisions for vacuuming.

R-107.7 Wading pool decks. When adjacent to swimming pools, wading pools shall be separated from the swimming pool by a barrier or fence of a minimum of 48 inches in height with self-latching and self-closing gates. When adjacent to areas less than 1 foot deep of zero depth entry pools, the fence or effective barrier is required if the water edges are less than 40 feet apart. Wading pools shall have a minimum 10-foot-wide deck around at least 50 percent of their perimeter, with the remainder of the perimeter deck being at least 4 feet wide. There shall be at least 10 feet between adjacent swimming pools and wading pools.

R-107.8 Lighting. Wading pools are exempt from underwater lighting requirements but shall have overhead lighting installed for night use.

SECTION R-108 SPA POOLS

R-108.1 General. Spa pools shall meet the requirements of Subsections R-101.3 through R-106.5, unless specifically indicated otherwise.

R-108.2 Color, pattern, finish. The color, pattern or finish of the pool interior shall not obscure the existence or presence of objects or surfaces within the pool.

R-108.3 Water depths. Spa-type pools shall have a minimum water depth of 2½ feet and a maximum water depth of 4 feet, except that swim spa pools may have a maximum water depth of 5 feet. Depth markers and “NO DIVING” markers are not required on spa-type pools with 200 square feet or less of water surface area.

R-108.4 Steps and handrails. Steps or ladders shall be provided, and shall be located to provide adequate entrance to and exit from the pool. The number of sets of steps or ladders required shall be on the basis of one for each 75 feet, or major fraction thereof, of pool perimeter. Step sets for spa-type pools with more than 200 square feet of pool water surface area shall comply with Subsection R-102.6. Step sets for spa-type pools with 200 square feet or less of pool water surface area shall comply with the following: Step treads shall have a minimum width of 10 inches for a minimum continuous tread length of 12 inches. Step riser heights shall not exceed 12 inches. Intermediate treads and risers between the top and bottom treads and risers shall be uniform in width and height, respectively. Contrasting markings on the leading edges of the submerged benches and the intersections of the treads and risers are required to be installed in accordance with Subsections R-102.6 and R-102.7.

R-108.4.1 Handrails shall be provided for all sets of steps, and shall be anchored in the bottom step and in the deck. Handrails shall be located to provide maximum access to

the steps and handrails shall extend 28 inches above the pool deck.

R-108.4.2 Where “figure 4” handrails are used, they shall be anchored in the deck and shall extend laterally to any point vertically above the bottom step. Handrails shall be located to provide maximum access to the steps and handrails shall extend 28 inches above the pool deck.

R-108.5 Decks. Decks shall have a minimum 4-foot-wide unobstructed width around the entire pool perimeter, except that pools of less than 120 square feet of pool water surface area shall have a minimum 4-foot-wide unobstructed continuous deck around a minimum of 50 percent of the pool perimeter. Decks less than 4 feet wide shall have barriers to prevent their use. Decks shall not be more than 10 inches below the top of the pool. For pools of 120 square feet or greater, 10 percent of the deck along the pool perimeter may be obstructed.

R-108.6 Therapy or jet systems.

R-108.6.1 The return lines of spa-type therapy or jet systems shall be independent of the recirculation-filtration and heating systems.

R-108.6.2 Therapy or jet pumps shall take suction from the collector tank. Collector tank sizing shall take this additional gallonage into consideration.

R-108.7 Filtration system inlets. Spa-type pools with less than 20 feet of perimeter shall have a minimum of two, equally spaced adjustable inlets.

R-108.8 Filtration recirculation. Spa-type pools shall have a minimum of one turnover every 30 minutes. The piping, fittings and hydraulic requirements shall be in accordance with Subsection R-106.5. All recirculation lines to and from the pool shall be individually valved with proportional flow-type valves in order to control the recirculation flow.

R-108.9 Vacuuming. Spa-type pools of more than 200 square feet of pool water surface area shall have provisions for vacuuming.

R-108.10 Combination spas/pools. When spa pools are part of a conventional swimming pool, the spa pool area shall be offset from the main pool area with the same water depth as the main pool area. The spa pool shall meet all the spa pool requirements of this Appendix, and the deck area at the spa shall be protected by connected 30-inch-high stanchions. The deck perimeter at the offset spa area shall not exceed 15 percent of the entire swimming pool perimeter. All benches shall have contrasting markings on the leading edges of the intersection of the bench seats. If tile is used, it shall be slip resistant.

R-108.11 Portable and wooden spa pools. Portable and wooden-type spa pools are prohibited.

SECTION R-109 WATER RECREATION ATTRACTIONS AND SPECIALIZED POOLS

R-109.1 General. Water recreation attraction projects shall be designed and constructed within the limits of sound engineering practice. Design engineers may consult with the Depart-

ment of Building and Safety in reference to concepts of design variations and to areas where potential problems may exist. In addition to the requirements of this Section, compliance is required with Subsections R-101.3 through R-106.5 depending upon the pool design and function. Additionally, all pools listed in this Section shall have a 2-hour turnover rate unless otherwise noted.

R-109.2 Water slides.

R-109.2.1 Water slide plunge pool. Plunge pools shall be constructed of concrete or other structurally rigid impervious materials, with a nontoxic, smooth and slip-resistant finish. The plunge pool design shall meet the criteria of Subsections R-109.2.1.1 through R-109.2.1.6.

R-109.2.1.1 Plunge pool water depth. The minimum plunge pool operating water depth at the slide flume terminus shall be 3 feet. This depth shall be maintained for a minimum distance of 10 feet in front of the slide terminus from which point the plunge pool floor may have a constant upward slope to allow a minimum water depth of 2 feet at the base of the steps. The floor slope shall not exceed one in 10. The plunge pool water depth shall be commensurate with safety and the ease of exit from the plunge pool.

R-109.2.1.2 Plunge pool dimension. The plunge pool dimension between any slide flume exit or terminus and the opposite side of the plunge pool shall be a minimum of 20 feet excluding steps.

R-109.2.1.3 Slide flume terminus.

R-109.2.1.3.1 The slide flume terminus shall be designed by the design engineer who can demonstrate to the department's satisfaction that riders will be adequately slowed prior to discharge so as to prevent injury or harm to the rider upon impact with the plunge pool water. The slide terminus shall be flush with the pool wall and located at or below the pool water level.

R-109.2.1.3.2 The minimum distance between any plunge pool sidewall and the outer edge of any slide terminus shall be 5 feet. The minimum distance between adjacent slide flumes shall be 6 feet.

R-109.2.1.3.3 A minimum length of slide flume of 10 feet shall be perpendicular to the plunge pool wall at the exit end of the flumes.

R-109.2.1.4 Plunge pool main drains. The plunge pool shall have a minimum of one main drain with separate piping and valve to the filtration system collector tank. The velocity through the openings of the main drain grate shall not exceed $1\frac{1}{2}$ feet per second at the design flow rate of the recirculation pump. The main drain piping shall be sized to handle 100 percent of the design flow rate of the filtration system with a maximum flow velocity of 3 feet per second.

R-109.2.1.5 Plunge pool floor slope. The plunge pool floor shall slope to the main drains and the slope shall not exceed one in 10.

R-109.2.1.6 Plunge pool decks.

R-109.2.1.6.1 Width. The minimum width of plunge pool decks along the exit side shall be 10 feet.

R-109.2.1.6.2 Slopes. All plunge pool decks shall slope to the plunge pool or pump reservoir; deck drains, which discharge to waste; or other acceptable means. All slopes shall be between 2- and 4-percent grade.

R-109.2.2 Run out lanes.

R-109.2.2.1 Run out lanes may be utilized in lieu of a plunge pool system, provided they are constructed to the slide manufacturer's specifications and are approved by the design engineer of record.

R-109.2.2.2 Five-foot-wide walkways shall be provided adjacent to run out lanes.

R-109.2.2.3 Minimum water level indicator markings shall be provided on both sides of the run out trough to ensure adequate water for the safe slowing of pool patrons.

R-109.2.2.4 Water park personnel shall be provided at the top of the slides and at the run out.

R-109.2.3 Pump reservoirs. Pump reservoirs shall be made of concrete or other impervious material with a smooth, slip-resistant finish. Pump reservoirs shall be for the slide pump intakes, but where properly sized may also be used as a collector tank for the filter system. Pump reservoir designs shall meet the criteria of Subsections R-109.2.3.1 through R-109.2.3.5.

R-109.2.3.1 Pump reservoir volume. The minimum reservoir volume shall be equal to 2 minutes of the combined flow rate, in gpm of all filter and slide pumps.

R-109.2.3.2 Pump reservoir security. Pump reservoirs shall be accessible only to authorized individuals.

R-109.2.3.3 Pump reservoir maintenance accessibility. Access decks shall be provided for the reservoir such that all areas are accessible for vacuuming, skimming and maintenance. The decks shall have a minimum width of 3 feet and shall have a minimum slope of 3:10 away from the reservoir.

R-109.2.3.4 Pump reservoir slide pump intakes. The slide pump intakes shall be located in the pump reservoir and shall be designed to allow cleaning without danger of operator entrapment.

R-109.2.3.5 The pump reservoir shall be fed by main drains within the plunge pool itself (either in the floor or sidewall). They shall have the maximum flow velocity of $1\frac{1}{2}$ feet per second through the main drain grating and 3 feet per second through piping to the reservoir.

R-109.2.4 Slide pump check valves. Slide pumps shall have check valves on all discharge lines.

R-109.2.5 Perimeter overflow gutters or skimmers. Plunge pools and pump reservoirs shall have a perimeter

overflow gutter system or skimmer, which shall be an integral part of the filtration system.

R-109.2.5.1 Perimeter overflow gutter systems. Perimeter overflow gutter systems shall meet the requirements of Subsection R-106.5.3.1, except that gutters are not required directly under slide flumes or along the weirs that separate plunge pools and pump reservoirs.

R-109.2.5.2 Surface skimmers. Surface skimmers may be used in lieu of perimeter overflow gutters, and shall be appropriately spaced and located according to the structural design. Unless an overflow gutter system is used, surface skimmers shall be provided in the plunge pool and in the pump reservoir, and the skimmer system shall be designed to carry 60 percent of the filtration system design flow rate with each skimmer carrying a minimum 30 gpm. All surface skimmers shall meet the requirements for NSF commercial approval as set forth in NSF/ANSI 50, which is incorporated by reference in these rules, including an equalizer valve in the skimmer and an equalizer line to the pool wall on systems with direct connection to pump suction.

R-109.2.6 Water slide recirculation-filtration equipment.

R-109.2.6.1 Recirculation rate. The recirculation-filtration system of water slides shall recirculate and filter a water volume equal to the total water volume of the facility in a period of 3 hours or less.

R-109.2.6.2 Filter areas. Minimum filter area requirements shall be twice the filter areas specified for the recirculation rates stipulated in Subsection R-106.5.5.1. The filtration system shall be capable of returning the pool water turbidity to 5/10 Nephelometric Turbidity Units within 8 hours or less after peak bather load.

R-109.2.6.3 Hair and lint strainer. Any filtration system pump, which takes suction directly from the plunge pool and reservoir, shall have a minimum 8-inch-diameter hair and lint strainer on the suction side of the pump.

R-109.2.7 Disinfection. The disinfection equipment shall be capable of feeding 12 mg/L of halogen to the continuous recirculation flow of the filtration system.

R-109.2.8 Slide design and construction is the responsibility of a professional engineer licensed in Florida and the applicant.

R-109.2.9 A lockable gate shall be provided at the stair or ladder entrance to the slide.

R-109.2.10 Upon construction completion, a professional engineer licensed in Florida shall certify that the slide was constructed in accordance with the manufacturer's specifications and is structurally sound.

R-109.3 Water activity pools.

R-109.3.1 Water activity pools shall be designed and constructed within the limits of sound engineering practice. The design engineer may consult with the Department

prior to preparation and submission of engineering plans and specifications for water activity pools.

R-109.3.2 Water activity pools shall be constructed of concrete or other structurally rigid, impervious materials with a nontoxic, smooth and slip-resistant finish. These pools shall be of such shape and design as to be operated and maintained in a safe and sanitary manner.

R-109.3.3 The recirculation-filtration system of water activity pools shall be capable of a minimum of one turnover every 2 hours for water activity pools more than 2 feet deep, and in 1 hour for these pools that are 2 feet deep or less.

R-109.3.4 Those portions of the activity pool where the water depth will not allow for the proper installation of underwater lighting, shall be provided with 6 footcandles of lighting on the deck and the water surface.

R-109.3.5 Fence requirements shall be in accordance with Subsection R-107.7.

R-109.3.6 Play features with an overhead clearance of less than 4 feet shall be blocked or barricaded to preclude children becoming entrapped.

R-109.4 Wave pools.

R-109.4.1 Wave pools shall be designed and constructed within the limits of sound engineering practice.

R-109.4.2 Wave pools shall be constructed of concrete or other impervious materials with a smooth, slip-resistant finish. These pools shall be of such shape and design as to be operated and maintained in a safe and sanitary manner.

R-109.4.3 The recirculation-filtration system of wave pools shall be capable of a minimum of one turnover every 3 hours.

R-109.4.4 Floors shall be sloped in accordance with the manufacturer's or design engineer's specifications, however, they shall not exceed the slope limits of Subsection R-102.3.3.

R-109.5 River rides.

R-109.5.1 River rides shall be constructed within the limits of sound engineering practice. The design engineer may consult with the Department of Building and Safety prior to preparation and submission of engineering plans and specifications for river rides.

R-109.5.2 River rides shall be constructed on concrete or other impervious materials with a nontoxic, smooth and slip-resistant finish. These rides shall be of such shape and design as to be operated in a safe and sanitary manner.

R-109.5.3 The recirculation-filtration system of the river ride shall be capable of a minimum of one turnover every 3 hours.

R-109.5.4 The maximum water depth of the river ride shall not exceed 3 feet unless justified to the department's satisfaction by the design engineer.

R-109.5.5 Decking shall be provided at the entrance and exit points as necessary to provide safe patron access, but shall not be smaller than 10 feet in width and length. Addi-

tional decking along the ride course is not required, except that decking shall be required, at lifeguard locations and emergency exit points.

R-109.5.6 Access and exit shall be provided at the start and end of the ride, and additional exit locations shall be located along the ride course as necessary to provide for the safety of the patrons.

R-109.5.7 Propulsion jets shall be installed in the walls of the river ride. In the alternative, propulsion jets may be installed in the floor if they are covered by a grate that will inhibit entrapment or injury of the pool patrons' feet or limbs.

R-109.6 Zero depth entry pools.

R-109.6.1 Zero depth entry pools shall have a continuous floor slope from the water edge to the deep end.

R-109.6.2 The deck-level perimeter overflow system with grate shall be provided at the water's edge across the entire zero depth portion of the pool.

R-109.6.3 The pool deck may slope toward the pool for no more than 5 feet, as measured from the overflow system grate outward. Beyond this area, the deck shall slope away from the pool in accordance with Subsection R-102.3.3.

R-109.6.4 No-entry, shallow water signs shall be provided along the pool wall edge where the water depth is less than 3 feet deep. No-entry signs shall be slip-resistant, shall have 4-inch-high letters, shall be located within 2 feet of the pool edge and shall be spaced no more than 15 feet apart.

R-109.6.5 Additional inlets shall be provided in areas of less than 18 inches deep. The numbers and location shall be such as to double the flow rate into this area.

R-109.6.6 The recirculation-filtration system shall have a minimum of one turnover every 2 hours in the area of the pool that is 3 feet deep or less. In the remainder of the pool where the depth is greater than 3 feet, the system shall have a maximum 6-hour turnover rate. The design plans submitted by the applicant shall provide the volume of water in the pool area of 3 feet depth and less, the volume of water in the pool area greater than 3 feet in depth, and the total volume in the pool for determination of minimum circulation flow. The volume calculations shall provide verification that the correct volume of water is used to determine the minimum flow at the 2-hour and 6-hour flow requirements.

R-109.6.7 Those portions of the zero depth entry pool, where the water depth will not allow for the proper installation of underwater lighting, shall be provided with 6 footcandles of lighting on the deck and water.

R-109.6.8 Play structures in a zero depth entry area (in depths of 0 to 3 feet) may be within 15 feet of the pool walls, but shall comply with sound engineering requirements for the safety of pool patrons.

R-109.7 Special-purpose pools.

R-109.7.1 General. Special-purpose pool projects may deviate from the requirements of other Sections of these rules provided the design and construction are within the

limits of sound engineering practice. Only those deviations necessary to accommodate the special usage shall be allowed and all other aspects of the pool shall comply with the requirements of this Section and with Subsections R-101.3 through R-106.5. The design engineer may consult with the department prior to preparation and submission of engineering plans for special-purpose pools.

R-109.7.2 A special-purpose pool may incorporate ledges that do not overhang into the pool.

R-109.7.3 The operating permit shall state the purpose for which the pool is to be used.

R-109.8 Interactive water features (IWFs).

R-109.8.1 Waters discharged from all fountain or spray features shall not pond on the feature floor, but shall flow by gravity through a main drain fitting to a below-grade sump or collection system, which discharges to a collector tank. The minimum size of the collector tank shall be equal to the volume of 2 minutes of the combined flow of all feature pumps and the filter pump. Smaller tanks may be utilized if hydraulically justified by the design engineer. Adequate access shall be provided to the sump or collector tank. Stairs or a ladder shall be provided, as needed, to ensure safe entry into the tank.

R-109.8.2 An automatic skimmer system shall be provided in the collector tank. A variable height skimmer may be used or a custom surface skimmer device may be substituted if deemed appropriate by both the design engineer and the department.

R-109.8.3 Chemical feeders shall be provided in accordance with Subsection R-106.5, except that the disinfection feeder shall be capable of feeding 12 ppm of free chlorine to the filter return piping (based upon a hypothetical 30 minute turnover of the contained volume within the system).

R-109.8.4 If night operation is proposed, 6 footcandles of light shall be provided on the pool deck and the water feature area. Lighting that may be exposed to the feature pool water shall not exceed 15 volts, shall be installed in accordance with manufacturer's specifications and be approved for such use by UL or NSF.

R-109.8.5 All electrical work shall comply with the NEC that is incorporated by reference.

R-109.8.6 Hydraulics.

R-109.8.6.1 The filter system shall filter and chemically treat all water that is returned to the spray features. The filter system shall draft from the collector tank and return filtered and treated water directly to the spray features. Excess water not required by the spray features shall be returned to the collector tank.

R-109.8.6.2 The water feature pump shall draft from the collector tank.

R-109.8.6.3 Alternatively, the contained volume of the system may be filtered and chemically treated based upon a 30-minute turnover of the contained volume with 100 percent returned to the collector tank by manifold piping. If this alternative is chosen, all water returned to

the spray feature(s) must also be treated with UV disinfection equipment to accomplish protozoan destruction in accordance with sound engineering and the requirements of Subsection R-106.5.16.6. This alternative must have the ability to feed 6 milligrams per liter free chlorine to the feature water as it is returned to the spray feature. The UV disinfection equipment shall be electrically interconnected such that whenever it fails to produce the required UV dosage, the water spray features pump(s) and flow will be immediately stopped.

R-109.8.6.4 The flow rate through the feature nozzles of the water features shall be such as not to harm the patrons and shall not exceed 20 feet per second unless justified by the design engineer and by the fountain system manufacturer.

R-109.8.6.5 An automatic water level controller shall be provided.

R-109.8.6.6 An overflow waste line with air gap shall be provided.

R-109.8.6.7 A means of vacuuming and completely draining the tank(s) shall be provided.

R-109.8.6.8 Where the filter system described in Subsection R-109.8.6.1 is utilized, a second filter system and disinfection system shall be provided to treat the water in the collector tank when the feature/filter pump is not in operation. Said system shall be capable of filtering the total volume of water in the collector tank in 30 minutes and the disinfection system shall be capable of providing 12 mg/L of disinfectant to this flow rate.

R-109.8.6.9 IWFs shall be fenced in the same fashion as wading pools as noted in Subsection R-107.7. Where the IWF is at least 50 feet from all other pools and is not designed to have any standing water, fencing requirements should be carefully considered by the applicant to control usage, but are not required by rule.

R-109.8.6.10 A minimum 4-foot-wide wet deck area shall be provided around all IWFs. The wet deck shall meet the requirements of Subsection R-103.1, however, up to 50 percent of the perimeter may be obstructed.

R-109.8.6.11 IWFs shall be constructed of concrete or other impervious and structurally rigid material.

R-109.8.6.12 Floor slopes of an IWF shall be a maximum 1 foot vertical in 10 feet horizontal and a minimum of 1 foot vertical in 50 feet horizontal.

R-109.8.7 Water theme parks. Shall meet all other aspects of these rules for the features provided.

R-109.8.7.1 Rules and regulations for water theme parks shall be posted in minimum 1-inch letters at each entrance to the park and shall contain the following:

- (a) No food, drink, glass or animals in the pool or on the pool decks.
- (b) Park operating hours ___ A.M. to ___ P.M.
- (c) Shower before entering.
- (d) Do not swallow the pool water.

R-109.8.7.2 Showers shall be provided at or near the entrance (queue) to a water recreation attraction.

R-109.8.7.3 Water theme parks are exempt from the fencing requirements of Subsection R-103.1.9, except that pools designed for small children shall be fenced when located within 50 feet of a pool with water depths of 3 feet or more.

R-109.8.7.4 Sanitary facilities within a water theme park shall be as near to the water recreation attractions as prudent to ensure patron use, but not more than 200 feet walking distance from any exit of a water attraction.

SECTION R-110 MODIFICATIONS

R-110.1 Modifications. Modifications include nonequivalent changes or additions to the recirculation system, treatment equipment, physical structure or appurtenances. Replacement of the pool or spa shell is considered to be construction of a new facility and shall be processed as such. The installation of new decking is not considered a modification if it is installed in compliance with Subsection R-103.1, and deck markings are upgraded in accordance with Subsection R-102.4. Resurfacing the pool interior to original nontoxic, slip-resistant and smooth specifications, or equivalent replacement of equipment, is not considered a modification. However, the following items shall be addressed during resurfacing projects:

R-110.1.1 The lip of the gutter must be leveled to within $\frac{1}{4}$ inch between the highest and lowest point, and the downward slope from the lip to the drain must be maintained as originally designed or increased, but shall not exceed new construction standards.

R-110.1.2 Tile step markings must be installed meeting the requirements of Subsection R-102.6.3.

R-110.1.3 Where applicable, the slope break marking must be installed meeting the requirements of Subsection R-102.3.3.2 and the safety line must be installed 2 feet before the marking.

R-110.1.4 Depth markers and “NO DIVING” markers must be installed in accordance with Subsection R-102.4.

R-110.1.5 The pool ladder must have a 3- to 6-inch clearance from the pool wall. New cross-braced ladder(s) shall be installed in place of noncross-braced ladder(s) in compliance with Subsection R-102.6.1 during a pool resurfacing.

R-110.1.6 Should resurfacing works affect the step riser heights, no riser shall exceed 12 inches and the intermediate risers shall be made uniform.

R-110.1.7 When fiberglass is used to resurface a pool, any existing tile shall not be covered by the fiberglass finish.

R-110.1.8 The applicable governing body shall be notified, in writing, of any proposed pool resurfacing or upgrades to decking at least 10 days prior to commencement. The notification shall include an itemized list of all proposed work that is to be performed, the license number

of the contractor selected and shall indicate that all work will meet the requirements of this Section.

R-110.1.9 Recessed treads that protrude from the pool wall shall be removed and replaced with a cross-braced ladder or reconstructed to meet the requirements of Subsection R-102.6.2.

R-110.2 The painting of pools shall not be considered a modification provided the following conditions are met:

- (a) Only paints designated by the manufacturer as pool paints are used.
- (b) All step stripes, slope break markers and safety line, and depth and “NO DIVING” markings shall be provided to comply with the applicable provision(s) of this Section.

R-110.3 The installation of copper or copper/silver ionization units and ozone generators capable of producing less than a pool water ozone contact concentration of 0.1 mg/L shall not be considered a pool modification provided compliance when the following is met:

- (a) The ionization or ozone generator unit complies with Paragraph 64E-9.007(16)(e), F.A.C.
- (b) The manufacturer provides one set of signed and sealed engineering drawings indicating the following:
 - 1. The unit does not interfere with the design flow rate.
 - 2. The unit and the typical installation meet the requirements of the NEC.
 - 3. A copper test kit and information regarding the maximum allowed copper and silver level and the minimum required chlorine level shall be available to the pool owner.
 - 4. The unit shall meet the requirements of the NSF/ANSI 50.
- (c) At least 7 days before the time of installation, the installer will provide a photocopy of the engineering drawings and a letter of intent identifying the pool on which the unit is to be installed.
- (d) Upon completion of the installation, a professional engineer or electrician licensed in the State of Florida shall provide a letter, to the county health department, indicating the unit was properly installed in accordance with the typical drawings, the NEC and with local codes.

EPCOT STANDARD 5-1

ELEVATORS, DUMBWAITERS, ESCALATORS, MOVING WALKS, MANLIFTS AND TRANSPORTING ASSEMBLIES

SECTION 5-1.101 ADMINISTRATIVE REQUIREMENTS

5-1.101.1 Scope. The requirements of this Standard shall apply to the design, construction, installation, operation, inspection, testing, maintenance, alteration and repair of elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, special-purpose elevators, manlifts, conveyors, cableways, derricks, hoists, jacks, slings, cranes, parking elevators and aerial passenger tramways.

Where these types of transporting devices are provided as an integral feature of an amusement ride or device, and where they differ significantly from the generic, conventional description in appearance, and in purpose, function, and use, those transporting devices shall be considered to be amusement rides and devices and shall be consistent with the applicable requirements set forth in EPCOT Standard 5-13.

5-1.101.2 Criteria.

- (a) Design, construction and operation of all devices enumerated in Subsection 5-1.101.1 and the devices to which they may be attached, or of which they are an integral part, shall comply with the requirements of the Florida Department of Business and Professional Regulation; the applicable provisions of this Code and the *EPCOT Mechanical Code*; and with the requirements of this Standard.
- (b) Such devices shall be in accordance with established principles of civil and mechanical engineering as specified in the nationally recognized Standards listed in Appendix A and this Standard, as applicable.
- (c) The Building Official may approve written specifications applicable to the design, construction, operation and maintenance of transporting assemblies not covered specifically by this Standard or the referenced standards incorporated herein. Such devices and equipment shall be consistent with the applicable criteria of this Subsection.
- (d) Where applicable, the following Standards shall be considered as part of this Standard:
 1. *Safety Code for Elevators and Escalators*, ASME A17.1 with A17.1a/CSA B44a Addenda, and the *Guide for Inspection of Elevators, Escalators, and Moving Walks*, ASME A17.2.
 2. *Safety Standard for Belt Manlifts*, ASME A90.1.
 3. *Safety Code for Conveyors, Cableways and Related Equipment*, ASME B20.1.
 4. *Safety Code for Existing Elevators and Escalators*, ASME A17.3.
 5. *Safety Standard for Platform Lifts and Stairways Chairlifts*, ASME A18.1.

Specifically Excluded:

- a. ASME A17.1 and supplements, Section 1200 General Requirements Rule 1200.1 Conformance with Safety Code for Existing Installations.
 - b. *Safety Standard for Mechanical Power-Transmission Apparatus*, ASME B15.1.
 - c. *Safety Code for Derricks*, ASME B30.6.
 - d. *Safety Code for Overhead and Gantry Cranes*, ASME B30.2.
 - e. *Safety Codes for Overhead Hoists (Underhung)*, ASME B30.16.
 - f. *Safety Code for Jacks*, ASME B30.1.
 - g. *Safety Standard for Powered Industrial Trucks*, ASTM B56.1.
 - h. *Safety Code for Aerial Passenger Tramways*, ANSI B77.1.
- (e) Glass used in elevator hoistways and elevator cars shall comply with Subsection 1005.10.

5-1.101.3 Existing installation. Elevators, dumbwaiters, escalators, moving walks and transporting assemblies existing at the time this Code and Standard were adopted may be used when they meet the requirements of the District for public safety.

5-1.101.4 Definitions. Terms and words used in this Standard have the meaning set forth in Chapter 2 and the Standards listed in Subsection 5-1.101.2(d), modified as follows:

- (a) **Alteration.** Any change to equipment, including its parts, components and/or subsystems, other than maintenance, repair or replacement.
- (b) **Automatic.** Self-activating, self-acting and self-regulating mechanism performing a required act at a predetermined point in an operation.
- (c) **Automobile parking elevator.** Elevator located either in a stationary or horizontal moving hoistway that is:
 1. Used solely for parking automobiles where attendants are normally stationed only on the receiving level.
 2. Where each automobile is moved on or off the elevator directly into parking spaces or cubicles in line with the elevator.
 3. Where an automobile is moved either under its own power or by a power-driven transfer device.
- (d) **Conveyance.** Elevator, escalator, dumbwaiter, manlift, automobile parking elevator, moving walk, aerial tramway, stairway chairlift, conveyor and the cableways, derricks, hoists, jacks, slings, cranes and other equipment and devices used in connection therewith.

- (e) **Conveyor.** Horizontal, inclined or vertical device for moving or transporting materials, packages or passengers in a path predetermined by the design of the device and having points of loading or discharge fixed or selective. (See ANSI B20.1.)
- (f) **Door closer.** Device to close elevator doors.
- (g) **Dual control.** Elevator equipped with automatic and manual controls.
- (h) **Elevator.** Hoisting and lowering mechanism serving two or more floors of a building or structure, equipped with a car or platform moving in guides in a vertical direction. (See this Code and ANSI A17.1.) A mechanism that is part of a registered attraction, as defined by Florida Statute 242.616 (2008), shall not be considered to be an elevator.
- (i) **Escalator.** Power-driven, inclined continuous stairways used exclusively for raising or lowering passengers.
- (j) **Hoistway (shaft).** Shaftway for travel of one or more elevators or dumbwaiters, including pit, terminating at the underside of the overhead machinery floor, or at the underside of the roof when the hoistway does not penetrate the roof.
- (k) **Manlift.** Device consisting of a power-driven endless belt provided with steps or platforms and with handholds attached to it, used for transporting persons from floor to floor, usually during construction.
- (l) **Manufacturer's agent.** The representative of the manufacturer of any device or equipment installed under the provisions of this Standard as specified in Subsection 5-1.101.1.
- (m) **Moving walk.** Passenger-carrying device on which passengers stand or walk in which the passenger-carrying surface remains parallel to its direction of motion and is uninterrupted. (For special types, see ASME A17.1.)
- (n) **Owner.** As defined in Chapter 2.
- (o) **Shaft.** See "Hoistway."
- (p) **Transporting assembly.** Manually operated, automatic or power-operated permanent or semi-permanent device (other than elevators, manlifts or dumbwaiters) used for transporting material or persons in a horizontal, vertical or inclined position or direction. Such assemblies shall include, but shall not be limited to, the following:
 1. Inclined devices with or without seats, not considered as elevators or escalators.
 2. Hoists or conveyors used for handling material during construction or demolition, or in processing industrial and commercial materials and products, as in Group B, H and I occupancies.

5-1.101.5 Responsibility. The owner shall be responsible for the safe operation and maintenance of every device and piece of equipment within the scope of this Standard as specified in Subsection 5-1.101.1.

5-1.101.6 Permits.

- (a) Application for a permit to install, relocate, alter or operate any device within the scope of this Standard shall be filed with the Building Official in accordance with the requirements of Chapter 3. When the device is approved by the Building Official, he shall issue a permit subject to the following conditions:
 1. Servicing repairs and replacements for normal maintenance made with parts using equivalent design and materials, and having equivalent strength and safety to the parts replaced, shall not require a permit, but shall be inspected and approved by the Building Official.
 2. Material hoists for construction operations shall comply with the requirements of Appendix F and with the requirements of Florida Statute 442. Such hoists may be constructed without a permit, but shall be approved by the Building Official. Men shall not be permitted to ride on material hoists, except as provided in the regulations of Florida Statute 442.
 3. No requirement in this Section nor in the manufacturers' specifications shall be construed as exempting a device that is within the scope of this Standard from compliance with the safety requirements of the District.
- (b) Application for a permit to install, relocate or alter an elevator, escalator, dumbwaiter or other transporting assembly or device specified in Subsection 5-1.101.1 shall be accepted only from persons and firms qualified under the laws of the State of Florida or the District to perform the required work.
- (c) Devices and structures within the scope of this Standard as specified in Subsection 5-1.101.1 shall not be used, nor occupied, unless they are in full compliance with the requirements of this Code and Standard.

SECTION 5-1.201 TESTING AND INSPECTION

5-1.201.1 Load tests. Passenger-carrying devices shall be tested and approved before being placed in service, as follows:

- (a) Elevators, escalators, moving walks, wheelchair lifts and special-purpose elevators as specified in ANSI A17.1.
- (b) Temporary devices.

5-1.201.2 Periodic inspections.

- (a) The owner shall cause periodic inspections to be made of any device regulated by this Standard in accordance with the times and schedules established by the Building Official. Such schedules shall include the following:
 1. Power-operated elevators, automobile parking elevators, escalators and moving walks, wheelchair lifts and special-purpose elevators; at least once each six months.

2. Elevator car and counterweight safeties, governors, and oil buffers; once every 12 months or in accordance with ANSI A17.1, whichever is the more restrictive requirement.
 3. Where no standard of inspection intervals is available in the documents of reference, the Building Official shall require inspections to be made as he considers necessary to assure safe operation of the device or equipment.
- (b) **Maintenance inspections and tests.** The owner shall cause maintenance inspections to be made by persons qualified by the District to perform such inspection under the laws of the State of Florida, of all devices and equipment specified in Subsection 5-1.101.1. Costs of such inspections and tests shall be paid by the owner. A complete and accurate report of all inspections and tests made shall be filed with the Building Official.
- (c) **Violations and unsafe equipment.** When an inspection reveals a violation of this Code or Standard, creating an unsafe condition, the Building Official shall have the authority to order discontinuance of the use of the equipment until it has been repaired, tested, replaced and reinspected in accordance with the requirements for new installations. If the Building Official finds that a violation has created a condition endangering human life, he shall cause to be placed a notice stating that the conveyance is unsafe. The notice shall be maintained in a conspicuous place until the unsafe conditions have been corrected. Such notice shall remain in place until removed by the Building Official when he is satisfied that the unsafe conditions have been corrected.
- (d) **Access for inspection.** Operational keys for fire-fighter service shall be provided in a centrally located, uniformly keyed, lock box. Location of the lock box shall be mutually agreed upon by the Reedy Creek Emergency Services, Department of Building and Safety, and the owner.

5-1.201.3 Reporting/inspections following accidents or incidents. The Building Official shall have access to the site of an accident to an elevator or other transporting device regulated by this Standard, and shall inspect the device and record all information pertaining to the accident, and shall keep an accident report on file. The site of an accident shall be protected from vandalism; and damaged construction, operating mechanisms or parts thereof shall not be removed from the site of the accident until approval has been obtained from the Building Official.

Following an accident, the elevator shall not be placed back into service until all repairs have been completed and the work inspected and approved by the Building Official.

Within five working days after any accident occurring in or upon any elevator, the Certificate of Operation holder shall report the accident to the District. Failure to timely file this report is a violation of Florida Statute and will subject the

Certificate of Operation holder to an administrative fine to be imposed by the District, in an amount not to exceed \$1,000.

SECTION 5-1.301 DESIGN AND CONSTRUCTION

5-1.301.1 Loads and stresses. Equipment and devices shall be constructed and designed to carry safely all loads to which such structures and devices may normally be subjected. Before being placed in operation and used by the public, all such devices shall be tested in accordance with the requirements of Subsection 5-1.201.1 and such other criteria as the Building Official may designate for impact, unbalanced and eccentric loads in accordance with the requirements of Chapter 9.

SECTION 5-1.401 CONVEYING SYSTEMS, ELEVATORS, ESCALATORS AND HOISTWAYS

5-1.401.1 Fire-protected enclosures.

- (a) Elevators and escalator openings through a floor/ceiling assembly shall be protected by a shaft enclosure complying with the provisions of this Section.

Exceptions:

1. Where the area of the floor opening between stories does not exceed twice the horizontal projected area of the escalators, the floor openings may be unenclosed if the floor opening involved is protected by a draft curtain in combination with closely spaced sprinklers. The draft curtain shall be located immediately adjacent to the opening, shall be 18 inches deep and shall be of substantially noncombustible material. Sprinklers, spaced not more than 6 feet apart, shall be placed 6 inches to 12 inches from the draft curtain on the side away from the opening to form a water curtain. Sprinklers in this water curtain shall be hydraulically designed to provide a discharge of 3 gallons per minute (gpm) per lineal foot of water curtain, measured horizontally around the opening with no sprinkler discharging less than 15 gpm. Nominal 1/2-inch orifice closed-head systems using sprinklers of Ordinary Temperature Classification are adequate for this purpose. When sprinklers are closer than 6 feet, cross baffles shall be provided. When sprinklers in the normal ceiling pattern are closer than 6 feet from the water curtain, it may be preferable to locate the water curtain sprinklers in recessed baffle pockets.
 2. A shaft enclosure is not required for elevator hoistways in open or enclosed parking garages that serve only the parking garage.
- (b) Not more than three elevators shall operate in the same hoistway (shaft) and a minimum rating of 2

hours shall be required for fire-resistive protection between contiguous hoistways.

- ➔ (c) In buildings housing all occupancies, elevator enclosures and machine rooms shall be of 2-hour fire-resistive construction.
- (d) Machine room doors shall be 1½-hour labeled.

Exception: Observation elevators, which are adjacent to a building wall without penetrating the separate fire-resistive areas of the building, shall comply with the provisions of ANSI A17.1.

5-1.401.2 Elevator lobbies and hoistway protection.

- (a) **Where required.** Elevator hoistway openings and enclosed elevator lobbies shall be provided where an elevator hoistway connects more than three stories.

Exceptions:

1. Protection of elevator hoistway door openings is not required where the elevator serves only open parking garages in accordance with Subsection 508.5.
2. Protection of elevator hoistway door openings is not required at the level(s) of exit discharge.
3. Enclosed elevator lobbies and protection of elevator hoistway door openings are not required on levels where the elevator hoistway opens to the exterior.
4. Where an area of refuge is required and an enclosed elevator lobby is provided to serve as an area of refuge, the enclosed elevator lobby shall comply with the *EPCOT Accessibility Code for Building Construction*.
5. Where fire service access elevators are provided, enclosed elevator lobbies shall comply with Subsection 5-1.402.

- (b) **Hoistway opening protection.** Where required protection of the elevator hoistway door opening, the protection shall be provided by one of the following:

1. An enclosed elevator lobby shall be provided at each floor to separate the elevator hoistway shaft enclosure doors from each floor by fire-resistance-rated walls in accordance with Section 707. In addition, doors protecting openings in the elevator lobby enclosure walls shall comply with Section 704 as required for corridor walls. Penetrations of the enclosed elevator lobby by ducts and air transfer openings shall be protected as required for corridors in accordance with Section 707.
2. Additional doors shall be provided at each elevator hoistway door opening that are readily openable from the car side without a key, tool, special knowledge or effort. Such door shall comply with the smoke and draft control door assembly requirements in Section 704 when tested in accordance with UL 1784 without an artificial bottom seal.
3. The elevator hoistway shall be pressurized in accordance with Subsection 720.21.

- (c) **Means of egress.** Elevator lobbies shall be provided with at least one means of egress complying with Chapter 10 and other provisions in this Code. Egress through an elevator lobby shall be permitted. Access to not less than one of the required exits shall be provided without travel through the enclosed elevator lobbies. Where the path of exit access travel passes through an enclosed elevator lobby, the level of protection required for the enclosed elevator lobby is not required to be extended to the exit unless direct access to an exit is required by other sections of this Code.

5-1.401.3 Prohibited uses, plumbing and mechanical systems.

Plumbing and mechanical systems shall not be located in an elevator shaft.

Exception: Floor drains, sumps and sump pumps shall be permitted at the base of the shaft provided they are indirectly connected to the plumbing system.

5-1.401.4 Electrical installations.

Electrical installations for elevators, escalators and similar transporting assemblies and devices shall comply with the requirements of the *EPCOT Electrical Code*. All installations shall be grounded.

5-1.401.5 Emergency power.

- (a) On buildings more than 75 feet high, emergency power shall be provided for not less than one elevator out of four or fraction thereof. In a bank of elevators, this emergency power shall be transferable to any other elevator. Emergency power shall be provided by an approved self-contained generator, set to operate within 60 seconds of a loss of normal power. The generator shall be located in a room separated from the remainder of the building by a 1-hour fire-resistive occupancy separation, except where a 2- or 3-hour occupancy separation is required by other provisions of this Code. The generator shall have a fuel supply sufficient to operate the generator for 2 hours.
- (b) Transfer between the normal and the emergency or standby power system shall comply with the provisions of ASME A17.1.

5-1.401.6 An approved pictorial permanent sign shall be installed immediately above each hall push button station on each floor reading: "In Fire Emergency, Do Not Use Elevator. Use Exit Stairs."

Exception: The emergency sign shall not be required for elevators that are part of an accessible means of egress complying with Section 407 of the *EPCOT Accessibility Code for Building Construction*.

5-1.401.7 A permanent sign shall be installed on each elevator machine room door reading "Danger—Electrical Equipment/Authorized Persons Only."

5-1.401.8 Fire protection.

- (a) Sprinklers shall not be installed in elevator hoistways and machine rooms.
- (b) Fire alarm initiating devices shall be located in the following areas:
 1. At each floor served by the elevator,
 2. Elevator machine rooms, and

3. Elevator hoistways, when required by the Building Official.

- (c) For high-rise structure detection and communication systems, see Section 718.

5-1.401.9 Electrolysis protection for underground hydraulic elevator cylinders. All newly installed underground hydraulic pressure cylinders shall be encased in outer plastic containment to minimize electrolytic corrosion between the metal cylinder and ground cathode.

- The plastic casing shall be capped at the bottom and all joints must be solvent or heat welded to ensure water tightness to prevent electrolysis to the hydraulic cylinders.
- The plastic casing shall be constructed of polyethylene or polyvinyl chloride (PVC). The plastic pipe wall thickness must not be less than 0.125 inch.
- A 1/2-inch pipe nipple with removable cap located between support channels, 6 inches above pit floor and 6 inches below pit floor, between PVC casing and cylinder for monitoring purposes.
- Monitoring shall be on a monthly basis.

Note: A minimum amount of dry sand may be used to stabilize hydraulic cylinders from movement between casings and cylinders. (See Figure 5-1.)

- (e) Replacements of existing hydraulic cylinders shall be protected by the aforementioned method where existing physical dimensions permit.

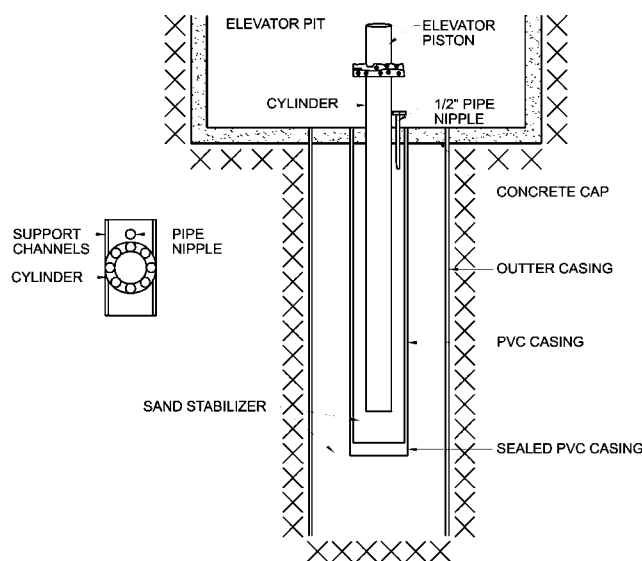


FIGURE 5-1

5-1.401.10 Machine rooms.

- Elevator machine rooms and machinery spaces not located over the hoistway shall have a clear headroom of not less than 7 feet.
- Spaces containing other elevator equipment shall have a clear headroom of not less than 54 inches.

- (c) Access to machine rooms and machinery spaces shall conform to ASME A17.1.

- (d) Venting – Elevator machine rooms that contain solid-state equipment for elevator operation shall be provided with an independent ventilation or air-conditioning system to protect against the overheating of the electrical equipment. The system shall be capable of maintaining temperatures within the range established for the elevator equipment.

- (e) Pressurization – The elevator machine room serving a pressurized elevator hoistway shall be pressurized on activation of a heat or smoke detector located in the elevator machine room.

- (f) Prohibited uses – Plumbing systems shall not be located in elevator equipment rooms.

5-1.401.11 Car and hoistway doors. Doors shall be provided with a door re-opening device, which will function to stop and re-open a car door and adjacent hoistway door in case the car door is obstructed while closing. Such device shall be operative at all times.

5-1.401.12 Sump pump in elevator pits. A sump pump or drain shall be provided in elevators with Firefighters Emergency Operations in accordance with ASME A17.1. An electrical outlet for damp locations in accordance with the *National Electrical Code* (NEC) shall be located within 4 feet of pump and 18 inches high from pit floor. Drains and sumps shall be installed in accordance with the *EPCOT Plumbing Code*. A sump pump cover shall be provided at floor level. In hydraulic units only, an oil separator shall be installed and water discharged indirectly into a sanitary system.

5-1.401.13 Escalator and moving walks. The exterior of trusses shall be enclosed with noncombustible materials.

5-1.401.13.1 Escalator guardrails. Escalators shall be provided with guardrails that comply with Subsection 503.11.

5-1.401.14 Elevators, escalators and moving walks with below-grade pits. Receptacles shall be ground-fault circuit interrupter type.

5-1.401.15 Elevator horizontally sliding door open and close time. The minimum time for opening size shall be as set forth in Table 401.15B.

TABLE 401.15B
MINIMUM OPENING SIZES FOR HORIZONTALLY
SLIDING ELEVATOR DOORS

INCHES	OPENING	SECONDS
36	Center	2.5
36	Single slide or two speed	3.1
42	Center opening	3.0
42	Single slide or two speed	4.4
48	Center	3.5
48	Single slide or two speed	4.8

5-1.401.16 Elevator car to accommodate ambulance stretcher. Any building that is more than one story must be constructed to contain at least one passenger elevator that is

operational for building occupants and fire department emergency access to all floors. The elevator car shall be of such a size and arrangement to accommodate an ambulance stretcher 24 inches by 81 inches with not less than 5-inch radius corners, in the horizontal, open position and shall be identified by the international symbol for emergency medical services (star of life). The symbol shall not be less than 3 inches high and shall be placed inside on both sides of the hoistway door frame.

5-1.401.17 Material lifts and conveyers. Material lifts and conveyers that are not classified as an elevator or dumbwaiter shall comply with ASME B20.1.

Lifts shall be permitted and inspected by the Department of Building and Safety. At the final inspection, a Certificate of Operation shall be posted in a conspicuous location in a frame with a transparent protective cover. The certificate shall be valid for one year. Inspections shall be performed every six months to certify the safety of the lift and its operation.

- (a) Lifts located in hotels, or similar buildings with overnight sleeping quarters, or subject to moving flammable material, or that penetrate a floor, shall be installed in a 2-hour fire-rated hoistway with 1½-hour “B” label hoistway doors.

Fire-rated doors shall be self-closing. Such doors may be held open for loading and unloading by a mechanical or electrical device that will release the door in case of fire.

- (b) Hoistway entrances shall have a combination electrical and mechanical lock to prevent the lift from operating with the door open or the opening of the door if the lift is 2 inches away from floor level. Means shall be provided to open the mechanical lock by a special key if the car is not at the landing. Vision panels may be used in the hoistway doors. Panel openings shall be glazed with wire glass, no less than ¼ inch thick. Openings shall reject a 6-inch ball with a maximum opening of 72 square inches.
- (c) Hoistways in an open area that do not penetrate a floor may be guarded with a wire grill or expanded metal that is at least 6 feet in height and that will reject a ball 2 inches in diameter. The doors shall have a combination mechanical and electrical lock. If the lift has an open side, front or ceiling, the hoistway shall have fixed guards on all sides. Metal guarding of hoistways in open areas and platform walls shall be so supported and braced solely as to deflect not more than 1 inch when a force of 100 pounds is applied at any point. Running clearance shall be no less than ¾ inch. Recesses or projections more than 2 inches shall be beveled at an angle of not less than 75 degrees with the horizontal.
- (d) Mechanical direction limits shall be provided to disconnect the power in both up and down directions. All hoistway wiring shall be enclosed and conform to applicable provisions of the *EPCOT Electrical Code*.
- (e) A call and send button with an emergency stop switch shall be located at each landing, arranged so it cannot

be reached from the car. A call and send button shall not be installed within the car or hoistway.

- (f) The machine room and machine spaces required for electrical installation and clearances shall comply with applicable provisions of the *EPCOT Electrical Code*. A disconnect shall disconnect power to the unit. It shall be located within sight of the power unit and controls. The controls may be located outside of the hoistway with a main disconnect. If the power unit is not in sight of the disconnect, a safety switch to prevent the operation of the unit shall be installed adjacent to the power unit and identified with a sign stating: “CAUTION! SWITCH WILL NOT REMOVE ALL POWER.” The controls shall be installed within a cabinet. The disconnect and control cabinet shall be lockable. The machine room or machine spaces shall have a guarded work light and receptacle. The receptacle shall be ground-fault circuit interrupter protected, not to exceed 20 amps. A machine room access door leading into a fire rated room or space shall be 1½-hour “B” labeled. The machine room door or access panel may require a switch to disconnect the power when the door is open. The door shall be self-closing and locking, and shall be openable only with a key. The lock shall be so arranged that the door can be opened from inside without a key. An access door that does not require body entry may be no less than 2 feet wide by 2 feet high. If body entry is required, a 24-inch by 78-inch-high door shall be provided.

- (g) The cab may be of solid or perforated metal. Perforated enclosures shall reject a ball 1½ inches in diameter. A solid metal car shall have a recessed light in the cab. Perforated enclosures may have hoistway lighting. Car doors or gates shall be provided with an electrical switch to prevent operation of the lift if the gate or door is open more than 2 inches. Lifts shall be posted with a sign that displays the lift capacity, restricts the use for materials only and prohibits riders. Lettering for such sign shall be at least 2 inches high.

Cars with only sidewalls and no ceiling shall have a sign posted in the car stating: “WARNING, MATERIAL NOT TO EXTEND PAST SIDEWALLS” in lettering at least 2 inches high.

- (h) A hydraulic pumping unit shall have an oil pressure gauge or means to connect a gauge on the pressure side of the unit. High-pressure units shall be set to bypass 10 percent above full load capacity. Car safeties shall be provided that are not direct plunger-type hydraulic lifts.
- (i) The car run-by at the top landing shall be no less than 3 inches.

Where a top is provided on the cab, the overhead clearance shall be not less than 24 inches when the car has reached its furthestmost travel. Cars with sidewalls only shall have not less than 6 inches clearance from any object to the ceiling of the hoistway, when the car has reached its furthestmost travel.

- (j) On drum-type machines, a slack cable switch shall be provided. A minimum of two ropes with a minimum

diameter of $\frac{3}{8}$ inch shall be used. The factor of safety for wire ropes shall be not less than 7.0.

5-1.401.18 Battery emergency return unit.

- (a) In the event of primary power failure, after 4 to 6 seconds, the hall and car buttons shall be inoperative, close the doors, and sound audible and visual signals to alert passengers that the car is returning to the designated level. When the car reaches the designated level, the door open button and detector will continue to operate normally after the doors open to allow passengers to exit. After the doors time out and close, the audible and visual signal will go off.

The door open button and detector will continue to operate in the car parked with the doors closed until after 5 minutes, the unit will turn off to prolong battery life.

The elevator will be able to resume normal operation when building power is restored if all elevator controls are in the normal position.

- (b) Enclosures shall be constructed as to ASME A17.5 and labeled by a nationally recognized testing laboratory. Control equipment, wiring, grounding, wiring methods, clearance and fuses shall comply with ASME A17.5, and the NEC.
- (c) A manual test switch shall be provided to test equipment for a simulated power failure. The switch shall be located outside of control enclosures and marked "TEST."

Routine inspections and tests shall be made at intervals not longer than six months. A written record indicating the inspection must be maintained on each unit and be available for review by the inspector.

- (d) A disconnecting means shall be provided to remove power from the emergency return unit when the main disconnect is in the open position.

5-1.401.19 Platform lifts. Platform lifts shall conform to the *EPCOT Accessibility Code for Building Construction*; Chapters 553 and 399 of the Florida Statutes; ASME A18.1 and A17.5; and the *National Electrical Code*.

A sign shall state: "PHYSICALLY DISABLED PERSONS ONLY. NO FREIGHT," in letters not less than 0.25 inches high and shall include the International Symbol of Accessibility. The passenger-restricting sign shall be securely fastened in a conspicuous place on the platform.

5-1.401.20 Personnel and material hoists. Personnel and material hoists shall be designed utilizing an approved method that accounts for the conditions imposed during the intended operation of the hoist device. The design shall include, but is not limited to, anticipated loads, structural stability, impact, vibration and stresses. The design shall account for the construction, installation, operation and inspection of the hoist tower, car, machinery and control equipment, guide members and hoisting mechanism. Additionally, the design of personnel hoists shall include provisions for field testing and maintenance which will demonstrate that the hoist device functions in accordance with the design. Field tests shall be

conducted on the completion of an installation or following alteration of a personnel hoist.

SECTION 5-1.402 FIRE SERVICE ELEVATORS— HIGH-RISE BUILDINGS OVER 120 FEET

5-1.402 Fire service access elevator. Elevators installed and operating in high rise buildings with an occupied floor more than 120 feet above the lowest fire department vehicle access shall have, at a minimum, two fire service access provided in accordance with this Section. Every floor of the building shall be served by a fire service access elevator. Except as modified in this Section, the fire service access elevator shall be installed in accordance with this Chapter and ASME A17.1/CSA B44.

5-1.402.1 Hoistway enclosures protection. The fire service access elevator shall be located in a shaft enclosure complying with this Code.

5-1.402.2 Hoistway lighting. When firefighters' emergency operation is active, the entire height of the hoistway shall be illuminated to not less than 1 footcandle as measured from the top of the car of each fire service access elevator.

5-1.402.3 Fire service access elevator lobby. The fire service access elevator shall open into a fire service access elevator lobby in accordance with Subsections 5-1.402.4.1 through 5-1.402.4.4.

Exception: Where a fire service access elevator has two entrances onto a floor, the second entrance shall be permitted to open into an elevator lobby in accordance with Subsection 708.14.1.

5-1.402.3.1 Access. The fire service access elevator lobby shall have direct access to an exit enclosure.

5-1.402.3.2 Lobby enclosure. The fire service access elevator lobby shall be enclosed with a smoke barrier having a minimum 1-hour fire-resistance rating, except that lobby doorways shall comply with Subsection 5-1.402.3.2.

Exception: Enclosed fire service access elevator lobbies are not required at the street floor.

5-1.402.3.3 Lobby doorways. Each fire service access elevator lobby shall be provided with a doorway that is protected with a $\frac{3}{4}$ -hour fire door assembly complying with Subsection 704.3. The fire door assembly shall also comply with the smoke and draft control door assembly requirements of Subsection 704.3(d) with the UL 1784 test conducted without the artificial bottom seal.

5-1.402.3.4 Lobby size. Each enclosed fire service access elevator lobby shall be a minimum of 150 square feet in an area with a minimum dimension of 8 feet.

5-1.402.4 Standpipe hose connection. A Class I standpipe hose connection in accordance with Subsection 715.2 and EPCOT Standard 7-14 shall be provided in the exit enclosure having direct access from the fire service access elevator lobby.

5-1.402.5 Elevator system monitoring. The fire service access elevator shall be continuously monitored at the fire

command center by a standard emergency service interface system meeting the requirements of NFPA 72.

5-1.402.6 Electrical power. The following features serving each fire service access elevator shall be supplied by both normal power and Type 60/Class 2/Level 1 standby power:

1. Elevator equipment.
2. Elevator hoistway lighting.
3. Elevator machine room ventilation and cooling equipment.
4. Elevator controller cooling equipment.

5-1.402.6.1 Protection of wiring or cables. Wires or cables that provide normal and standby power, control signals, communication with the car, lighting, heating, air conditioning, ventilation and fire-detecting systems to fire service access elevators shall be protected by construction having a minimum 1-hour fire-resistance rating or shall be circuit integrity cable having a minimum 1-hour fire-resistance rating.

SECTION 5-1.403 SERIAL NUMBERS

5-1.403 Serial numbers. Each elevator shall have a serial number assigned by the authority having jurisdiction painted on or attached to the elevator car in plain view and also to the driving mechanism. This serial number shall be shown on all required certificates and permits.

5-1.403.1 Certificates of operation must be posted in a conspicuous location in the elevator and shall contain the text of Subsection 823.12 *Florida Statute* relating to the prohibition against smoking in elevators. The certificate must be framed with a transparent cover.

5-1.403.2 The designation “NO SMOKING,” along with the international symbol for no smoking, shall be conspicuously displayed in the interior of the elevator in the plain view of the public.

5-1.403.3 The following ASME A17.1 and ASME A17.3 rules are hereby amended to read as follows:

- (a) Rule 2.29.1 of ASME A17.1 is amended to add the following to the rule: “Each car in a multicar group shall be sequentially identified from left to right, as viewed from the elevator lobby.”
- (b) Rule 2.7.3.1 of ASME A17.1 is amended to read as follows: “Rule 2.7.3.1 General Requirements. A permanent, safe and convenient means of access to elevator machine rooms and overhead machinery spaces shall be provided for authorized persons. The key to the machine rooms and overhead machinery spaces shall be kept on the premises at all times and readily available for use by State of Florida certified Elevator Inspectors.”
- (c) Rule 3.11.3 of ASME A17.3 is amended to read as follows:

NOTE: Updates to the *Safety Code for Existing Elevators and Escalators* ASME A17.1 and ASME A17.3 which require Phase II Fire-

fighters’ Service shall apply except where Subsection 399.02(9) *Florida Statute* states Phase II Firefighters’ Service on elevators may not be enforced until July 1, 2015, or until the elevator is replaced or requires major modification, whichever occurs first, on elevators in condominiums or multifamily residential buildings, including those that are part of a continuing care facility licensed under Chapter 651, or similar retirement community with apartments, having a Certificate of Occupancy by the local building authority that was issued before July 1, 2008. This exception does not prevent an elevator owner from requesting a variance from the applicable codes before or after July 1, 2015. This Subsection does not prohibit the Building Official from granting variances pursuant to Subsection 120.542 *Florida Statute* or other applicable rules and regulations.

SECTION 5-1.404 ALTERATIONS TO ELECTRIC AND HYDRAULIC ELEVATORS AND ESCALATORS

5-1.404.1 Alterations to electric and hydraulic elevators and escalators. Alterations set forth in Part 8, ASME A17.1 to include any change to equipment, including its parts, components, and/or subsystems other than maintenance, repair, or replacement require an elevator construction permit, along with documented performance of inspections and tests, to determine conformance with ASME A17.1. A repair or replacement of equipment, parts, components or subsystems that requires inspection, tests and independent witnessing in other sections of ASME A17.1, A17.3 and A18.1 shall require an elevator construction permit.

EPCOT STANDARD 5-12

SAFETY STANDARD FOR AMUSEMENT ATTRACTIONS AND AMUSEMENT BUILDINGS

SECTION 5-12.101 ADMINISTRATIVE REQUIREMENTS

5-12.101.1 Scope. The requirements of this Standard shall apply to the design, construction, installation, use, inspection, testing, maintenance, alteration and repair of amusement buildings and attractions and structures as defined in Subsection 5-12.101.3.

5-12.101.2 Criteria.

- (a) Design, construction and use of all buildings and attractions enumerated in Subsection 5-12.101.1 shall comply with the requirements of the EPCOT Codes, Subsection 103.1 and this Standard.
- (b) Such devices shall be in accordance with established principles of engineering as specified in the nationally recognized standards listed in Appendix A, the *EPCOT Mechanical Code* and this Standard, as applicable.
- (c) The Building Official may approve written specifications applicable to the design, construction, use and maintenance of amusement attractions not covered specifically by this Standard or the referenced standards incorporated herein. Such attractions shall be consistent with the applicable criteria of this Subsection.
- (d) Where there is a conflict between requirements within the body of this Code and Standard, the requirements of the Code shall apply.

5-12.101.3 Definitions.

- (a) **Amusement attraction.** Any building or structure around, over or through that persons may move or walk without the aid of any moving device integral to the building or structure, which building or structure provides amusement, pleasure, thrills or excitement. The term does not include enterprises principally devoted to the exhibition of products of agriculture, industry, education, science, religion or the arts.
- (b) **Owner.** As defined in Chapter 2.
- (c) **Show area.** The area of an amusement building or attraction that guests are exposed to. The volume of the show area shall include all spaces not separated from the show area.
- (d) **Special amusement building.** Any building or portion thereof, whether temporary, permanent or mobile, used for amusement, entertainment or education containing a device or system that conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the egress path is not readily apparent due to visual or audio distractions or is intentionally confounded, or is not readily available due to the nature of the attraction or mode of conveyance through the building or structure.

- (e) **Special inspector.** An inspector not employed by the owner or the District, specifically qualified to perform inspection of amusement buildings and attractions.
- (f) **Temporary amusement building or attraction.** An amusement building or attraction designed to be relocated from time to time with or without disassembly.

5-12.101.4 Responsibility. The owner shall be responsible for the safe operation and maintenance of every building and attraction within the scope of this Standard as specified in Subsection 5-12.101.1.

5-12.101.5 Permits. Application for a permit to install, relocate, substantially rebuild or substantially modify so as to change the structure or capacity of the building or attraction, or operate any building or attraction within the scope of this Standard, shall be filed with the Building Official in accordance with the requirements of Chapter 3.

SECTION 5-12.201 TESTING AND INSPECTION

5-12.201.1 Periodic inspections.

- (a) The owner/operator shall cause periodic inspections to be made of any building and attraction regulated by this Standard.
- (b) Where no standard of inspection intervals is available in the documents of reference, the Building Official shall require inspections to be made as he considers necessary to assure safe operation of the building or attraction.

5-12.201.2 Violations and unsafe conditions. When an inspection reveals a violation of this Code or Standard, creating an unsafe condition, the Building Official shall have the authority to order discontinuance of use until the violation or condition has been corrected. If the Building Official finds that a violation has created a condition endangering human life, he shall cause to be placed a notice stating that the conveyance is unsafe. The notice shall be maintained in a conspicuous place until the unsafe conditions have been corrected. Such notice shall remain in place until removed by the Building Official when he is satisfied that the unsafe conditions have been corrected.

5-12.201.3 Inspection following accidents. The Building Official shall be notified by the owner and have access to the site of an accident involving a building or attraction regulated by this Standard, provided such accident was the direct result of a building or attraction malfunction or operator error, and resulted in injury or death. The Building Official shall inspect the building or attraction and record all information pertaining to the accident, and shall keep an accident report on file. The site of an accident shall be protected from vandalism; and damaged construction, operating mechanisms or parts thereof

shall not be removed from the site of the accident until approval has been obtained from the Building Official.

Following an accident, the building or attraction shall not be placed back in service until all repairs have been completed and the work inspected and approved by the Building Official.

SECTION 5-12.301 DESIGN AND CONSTRUCTION

5-12.301.1 Types of construction. Buildings or attractions specified in Subsection 5-12.101.1 shall comply with the types of construction specified in Chapters 6 and 7. Where the type of construction is not clearly identified therein, the Building Official shall designate the required type of construction in accordance with the occupancy requirements of the building or attraction. Catwalks shall be constructed of noncombustible materials. Fire protection of steel and iron may be omitted.

5-12.301.2 Interior finish. The interior finish within amusement attractions and special amusement buildings shall be Class 1 throughout the show space and queue area in accordance with Section 711.

SECTION 5-12.401 AMUSEMENT BUILDINGS AND AMUSEMENT ATTRACTIONS

5-12.401.1 Exits.

- (a) Means of egress from amusement buildings and attractions, including stairways and platforms, ramps, fences and barricades, seats for spectators and safe dispersal areas, shall comply with the applicable requirements of Chapter 8 as specified by the Building Official.
- (b) Catwalks shall comply with the specific catwalk requirements found in Appendix M.
- (c) **Exit illumination and signs.** Exit illumination and signs shall meet the requirements of Chapter 8. Where mirrors, mazes or other designs are used that confound the means-of-egress path, approved low-level exit signs and directional path marking shall be provided and located no more than 8 inches above the walking surface on or near the egress path.

5-12.401.2 Fire prevention.

- (a) Fabrics used in amusement buildings and attractions, shall be made fire resistant in accordance with the requirements of the *EPCOT Fire Prevention Code*, and EPCOT Standards 5-13 and 6-1, as applicable. Approved fire extinguishers shall be provided where required by the *EPCOT Fire Prevention Code*. Flammable waste shall be kept in metal cans located as required in the *EPCOT Fire Prevention Code*. Gasoline or other flammable liquids and flammable gases shall not be stored in or near amusement buildings or attractions, or exitways, unless the storage area is specifically designed for such safe storage. Smoking shall be prohibited where required by the *EPCOT Fire Prevention Code*; signs shall be posted in accordance with the *EPCOT Fire Prevention Code*.

- (b) **Air compressors and equipment.** Air compressors, air compressor tanks and air compressor equipment shall be constructed, operated and maintained to ensure safe conditions. They shall be inspected at intervals established by the Building Official and a record of each inspection shall be available. Maximum allowable working pressure shall be marked on air compressors and their equipment.

5-12.401.3 Electrical wiring and equipment.

- (a) Transformers shall be enclosed and warning signs shall be posted thereon.
- (b) Overcurrent protective devices shall be provided according to the load. Such devices shall not be installed in neutral or grounding conductors.
- (c) Wiring shall not be installed on surfaces traversed by vehicles or pedestrians, except for temporary use. Such temporary wiring shall comply with Subsection 5-12.501.4(c).
- (d) Every electrically powered amusement device shall be grounded. The grounding shall be in accordance with the requirements of the *EPCOT Electrical Code*. Where noncurrent-carrying metal parts exposed to contact by passengers or operators may be energized, special grounding shall be provided. An effective ground shall be one having no greater than 25 ohms resistance. Where electric power is supplied from a privately operated generator system, the generator and its components shall be grounded when required by the Chief Electrical Inspector. All receptacles and attachment caps shall be of the grounding type.

5-12.401.4 Smoke control. A smoke control system shall be designed to control the migration of products of combustion in the show space. Upon detection of a fire, the system shall shut down the air supply to the fire floor and the return air from all nonfire floors.

- (a) Show spaces shall have a smoke exhaust system located at the ceiling. Such system shall be designed in accordance with Section 720 and shall be not less than 40,000 cubic feet per minute per smoke zone. Supply inlets shall be provided at the lowest level of the show area.
- (b) When the heights of the show area exceeds three stories, an exhaust system shall be provided as required in Paragraph (a), however, supply air shall be introduced mechanically from the floor of the show area. The capacity of the supply shall be 75 to 85 percent of the exhaust.

SECTION 5-12.501 TEMPORARY AMUSEMENT BUILDINGS AND ATTRACTIONS

5-12.501.1 Criteria. Amusement buildings or attractions designed to be moved or relocated shall comply with the applicable requirements of Sections 5-12.101, 5-12.201, 5-12.301, 5-12.401 and the provisions of this Section.

5-12.501.2 Prohibited use. Temporary amusement buildings or attractions that are not assembled in accordance with the

requirements of this Section, or that are defective, or are unsafe in any part, component, safety equipment or controls shall not be used or occupied. If the Building Official finds that a temporary amusement building or attraction presents an imminent danger, he may prohibit the use thereof and attach to such a warning notice. Such notice shall not be removed until the condition is made safe, tested and approved for use as provided in Section 310.

5-12.501.3 Inspection and certification. Inspection and certification of temporary amusement buildings and attractions shall comply with the requirements of Section 5-12.201.

5-12.501.4 Assembly and disassembly.

- (a) Temporary amusement buildings and attractions shall be assembled and disassembled in accordance with the requirements of this Subsection.
- (b) Parts or fastenings that are worn or damaged shall not be used. Close visual inspection shall be made of all parts and fastenings during assembly to discover any wear or damage and to assure that fastenings have been correctly installed.
- (c) Temporary electrical wiring used in the assembly of temporary amusement buildings and attractions shall comply with the requirements of the *EPCOT Electrical Code*. In areas where it is necessary to install temporary wiring over surfaces traversed by vehicles or pedestrians, the wiring shall be protected from wear and shall be installed so that it is not hazardous. Temporary wiring shall be removed when the temporary building or attraction is disassembled.

5-12.501.5 Air-inflated and air-supported. See Appendix N-301.10.

SECTION 5-12.601 SPECIAL AMUSEMENT BUILDINGS

5-12.601.1 Scope. Special amusement buildings shall meet the requirements of the appropriate assembly use group in addition to the requirements of this Section.

5-12.601.2 Smoke detectors. A supervised smoke detection system shall be installed in all special amusement buildings in compliance with EPCOT Standard 7-22. This smoke detection system shall either be cross-zoned or shall utilize an approved verification system.

Exception: Smoke detectors are not required in buildings or portions thereof that are essentially open to the outside air.

5-12.601.3 Sprinklers.

- (a) An approved automatic sprinkler system complying with EPCOT Standard 7-10 and Section 715 shall be installed in all special amusement buildings.
- (b) When the special amusement building is mobile, the sprinkler water supply may be by an approved temporary means.

5-12.601.4 System response.

- (a) The activation of two cross-zoned smoke detectors within a single protected area, a single detector monitored by an alarm verification zone or the automatic sprinkler system shall:
 - 1. Cause illumination of the means of egress with light of not less than 1 footcandle at the walking surface level.
 - 2. Stop any conflicting or confusing sounds and visuals.
 - 3. Activate an approved directional exit marking that will become apparent in an emergency.
- (b) Activation of any single smoke detector shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated.

5-12.601.5 Exit marking. Exit signs shall be installed at required exit doorways. Approved directional exit markings shall also be provided and shall include signs as set forth in the exit provisions of this Code, and be linear or strip on or near the floor identifying the exit path.

5-12.601.6 Public address system. A public address system, which may also serve as an alarm system, shall be provided and shall be audible throughout the entire special amusement building.

EPCOT STANDARD 5-13

STANDARD ON AMUSEMENT RIDES AND DEVICES

SECTION 5-13.101 ADMINISTRATIVE REQUIREMENTS

5-13.101.1 Scope.

- (a) This Standard establishes requirements for the design, manufacture, installation, inspection, testing, use and maintenance of amusement rides and devices. For those subjects for which it provides specifications, this Standard supersedes all existing EPCOT Standards.
- (b) Where amusement rides or devices resemble, in whole or in part, systems commonly used for other applications, manufacturers shall review the reference documents section of this Standard for requirements that might be appropriate to apply.
- (c) Owner/operators and manufacturers, as defined herein, shall be required to demonstrate compliance with this Standard to the Department of Building and Safety.

5-13.101.2 Purpose. The purpose of this Standard is to define program requirements for the safety of applicable amusement rides and devices.

Exceptions:

- 1. Exceptions to the requirements herein may, from time to time, be required. Where they occur, they shall be justified by engineering data, and only upon a sound, documented, safety basis, as approved by the Building Official.
- 2. The use of this Standard or future revisions of this Standard shall not require modifications of existing amusement rides and devices unless deemed necessary, on a case-by-case basis, in the interest of public safety.

5-13.101.3 Definitions.

- (a) **Aerial passenger tramway.** A passenger conveying system consisting of carriers that are not in direct contact with the ground, and in which the carriers circulate around a closed system and are propelled by a wire rope or chain. Refer to EPCOT Standard 5-1 for requirements applicable to those aspects of this system that are not specified in this Standard.
- (b) **Amusement device.** Any mechanical device or combination of devices that carries or conveys passengers on, along, around, over or through a fixed or restricted course or within a defined area for the purpose of giving its passengers amusement pleasure or excitement.
- (c) **Amusement ride.** A combination of amusement devices that constitute a total ride system.
- (d) **Amusement ride and device structures.** Structures supporting amusement rides and devices that are stati-

cally and/or dynamically loaded by the ride or device. Amusement ride and device structures shall not be considered as buildings.

- (e) **Block system.** A system used in certain rides to keep vehicles separated by dividing the ride into zones within which a single vehicle can be isolated. The vehicle's passage into and out of that zone is then monitored and coordinated with the activities in adjacent zones.
- (f) **Installation or erection.** The act of on-site construction or the physical setting up and making ready for use of a ride or device.
- (g) **Major modification.** Any change in either the structural or operational characteristics of the ride or device, which will significantly alter its performance from that specified in the manufacturer's design criteria.
- (h) **Manufacturer.** That party producing and/or supplying the physical product (ride or device) either as a system in total, or as part of a system; major modification, replacement parts or repair, including design, engineering, construction, fabrication, quality control and, if appropriate, installation.

The specific roles of the manufacturer may at times be assumed by various alternative parties within the manufacturer's or owner/operator's organization. Any party assuming the role of the manufacturer shall be required to comply with the manufacturer's responsibilities as defined in this Standard.

- (i) **Minor modification.** Any change that does not alter the structural or operational characteristics of the ride or device, nor change its performance from that specified in the manufacturer's design criteria.
- (j) **Owner/operator.** Those who operate and maintain the product (ride or device).
- (k) **Prototype.** Final operational assembly of a newly developed ride or device.

SECTION 5-13.201 DESIGN AND MANUFACTURE

5-13.201.1 Purpose. The purpose of this Section is to provide manufacturers with design references and criteria applicable to the design, manufacture and major modification of amusement rides and devices.

5-13.201.2 Referenced documents. Where applicable, the following Standards shall be considered as part of this Standard:

<i>ASTM Standards on Amusement Rides and Devices</i>	ASTM F24-2009 As compiled within the Annual Book of ASTM Standards, Volume 15.07
<i>Aluminum Construction Manual</i> by the Aluminum Association	EPCOT Standard 1002-1
American Welding Society Standards	EPCOT Standard 1009-5
<i>Automotive and Off-Highway Air Brake Reservoir Performance and Identification Requirements—Truck and Bus</i>	SAE J-10
<i>Boiler and Pressure Vessel Code, Section VIII, Division 1</i>	ASME B31.4-2001
<i>Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications"</i>	<i>EPCOT Mechanical Code, Chapter 16</i>
D.O.T. 3A/3AA for CNG Cylinders E-7277	49 CFR-173.34, Oct. 1, 1997
<i>Manual of Steel Construction Machinery's Handbook</i> , 25th Edition	EPCOT Standard 1009-1
<i>National Design Standards for Wood Construction</i>	EPCOT Standard 1010-1
<i>National Electrical Code</i>	NFPA 70-2011
<i>Overhead and Gantry Cranes</i>	ASME B30.2-2016
<i>Overhead Hoists (Underhung)</i>	ASME B30.16-2012
<i>Passenger Ropeways—Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors</i>	ANSI B77.1-2006
"Pediatric Growth Development Chart 1983" by U.S. Department of Health, Education and Welfare	
<i>Recommended Practice USA Human Physical Dimensions</i>	SAE J833
<i>Safety Code for Conveyors, Cableways and Related Equipment</i>	EPCOT Standard 5-1
<i>Safety Code for Elevators, Dumbwaiters and Moving Walks</i>	EPCOT Standard 5-1
<i>Safety Code for Jacks</i>	ANSI/ASME B30.1
<i>Safety Standard for Manlifts</i>	EPCOT Standard 5-1
<i>Safety Standard for Mechanical Power Transmission Apparatus</i>	EPCOT Standard 5-1
<i>Safety Standard for Powered Industrial Trucks</i>	ANSI/ASTM B56.1
<i>Standard Handbook for Mechanical Engineers</i> , 10th Edition	

5-13.201.3 Testing. Tests appropriate to be performed by the manufacturer may be found in Subsection 5-13.501.

5-13.201.4 Passenger weights.

- (a) For vehicles carrying seven or more passengers, the weight assigned to an adult passenger, for design purposes, shall be 170 pounds or 12 pounds per inch of hip width at the seat, whichever is greater. Reference SAE Recommended Practice, USA Human Physical Dimensions SAE J833 using the Medium Man for passenger weight.

- (b) For individual vehicles carrying six or less passengers, the weight assigned to an adult passenger, for design purposes, shall be 200 pounds or 14 pounds per inch of hip width at the seat, whichever is greater.

Exception: Alternative weights may be assigned if approved by the Building Official.

- (c) The weight assigned to a 12 year-old child passenger, for design purposes, shall be 90 pounds or 9 pounds per inch of hip width at the seat, whichever is greater. Reference Pediatric Growth Development Chart 1983, published by the U.S. Department of Health, Education and Welfare.

5-13.201.5 Passenger carrying devices.

(a) Design of passenger carrying units.

1. Passenger seating shall be designed to provide adequate support, padding and containment for the passenger's body, during operation, consistent with the design intent of the ride or device with consideration given, but not limited to, speed and forces on passengers.
2. The interior and exterior surfaces of all passenger carrying units of amusement rides and devices shall be designed and constructed so as to be free from sharp, rough or splintered surfaces, and protruding features that might constitute a hazard.

(b) Methods of restraint.

1. Passenger restraint, where appropriate, shall be based on the design intent of the ride or device with consideration given, but not limited to, height, speed and forces on passengers.
2. Passenger restraining devices, if provided, shall be of a type that cannot be released without intention.

- (c) **Passenger clearance.** Clearance shall be designed to minimize the opportunity for contact between a contained passenger and any object where said contact may reasonably be considered as likely to cause passenger injury during operation of a ride or device.

5-13.201.6 Amusement ride and device structures.

(a) Steel and aluminum structures.

1. Steel facility structures shall be designed in accordance with the *Manual of Steel Construction*, published by American Institute of Steel Construction.
2. Aluminum structures shall be designed in accordance with the specifications for aluminum structures, *Aluminum Construction Manual*.

- (b) **Timber structures.** Timber structures shall be designed in accordance with *The Wood Handbook* published by the U.S. Department of Agriculture Forest Products Laboratory (USDA Agricultural Handbook 72, Revision 0).

- (c) Allowable loads or stresses as indicated by Paragraphs (a) and (b) data, shall be reduced as deemed adequate by the manufacturer, to allow for special combinations

of conditions that may include, but are not limited to, method of construction, stress concentrations, shock, dynamics, load cycles, degree of risk and environment.

- (d) **Welding.** Welding of critical components shall be in accordance with the American Welding Society (AWS) and/or American Society of Mechanical Engineers (ASME) Standards and performed by appropriately certified welders.

- (e) **Bolting specifications.**

1. All fasteners used on a ride in connecting components shall meet accepted engineering standards, such as SAE, ASTM, IFI, ANSI, and applicable structural codes for each application in the system and shall be grade marked or otherwise identifiable.

2. Fasteners shall properly fit their fastening holes.

- (f) **Chain and wire rope.** Chain and wire rope used in ride systems shall meet existing industrial ratings considering the loads, conditions, dynamics and potential fatigue involved.

5-13.201.7 Electrical.

- (a) Electrical components shall be designed, manufactured and installed in accordance with the *EPCOT Electrical Code* or equivalent.
- (b) Emergency stop circuits shall be energized systems, which are fail-safe in case of power failure.
- (c) Emergency stop switches shall be manually reset. Resetting of the stop switch shall not start the ride.

5-13.201.8 Hydraulic. The criteria for design and manufacture of fixed and portable amusement rides and devices shall be ANSI (NFPA/JIC) T2.24.1 or equivalent. Deviations from or changes to ANSI T2.24.1 shall be as follows:

- (a) **Higher temperature operation.** Changes to ANSI T2.24-1, Section 6.7.1, shall be permitted only when components are designed and tested for higher temperature operation and adequate shielding is provided to prevent hot fluid from reaching any passenger or observer on or near the ride or device.
- (b) **Access to controls.** Adjustments of control shall not require access between, over or in close proximity to moving equipment or parts.
- (c) **Emergency safety device or means.** Where the possibility exists that undesirable motion will result due to an emergency or uncontrolled stop condition, a device or means shall be provided in the proportional or servo control circuit to prevent such motion.
- (d) **Operation of filtration.** Filters shall be sized for a minimum of 800 hours of operation under normal system conditions.
- (e) **Diagnostic pressure test points.** Pressure test points installed in the hydraulic circuit for system verification of pressure shall be accessible, and where pressure can be adjusted from the main system pressure.
- (f) **System oil test.** Sample test points, close to hydraulic pumps, as well as other key locations, shall be installed for the purpose of testing the fluid for contamination.

These test points shall be made safe and reliable access points to the system while under pressure.

- (g) **Position limits.** Effective means shall be provided to prevent a linear actuator, where piston and rod are the same diameter, from traveling beyond the physical limits of the actuator.
- (h) **System failures.** In the event of a system failure or malfunction of the hydraulic system, the velocity or acceleration, or both, shall be controlled with respect to forces acting on the passengers.

5-13.201.9 Pneumatics.

- (a) Maximum pressure shall not exceed component rating.
- (b) Pneumatic storage tanks shall conform to ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 1, or SAE J-10.
- (c) Pneumatic accumulators shall conform to ASME *Boiler and Pressure Vessel Code*.
- (d) Pneumatic tubing, hose and fittings shall conform to SAE Standards or equivalent.
- (e) Loss of air pressure below design minimums in critical applications, shall cause the system to revert to the appropriate fail-safe mode.
- (f) Where deemed appropriate by the manufacturer, pneumatic systems shall include components to provide lubrication, filtration, moisture extraction and pressure limiting.
- (g) Where deemed appropriate by the manufacturer, provisions shall be made for dumping accumulator tanks when systems are shut down.
- (h) Maximum allowable working pressures shall be marked on all compressors and their equipment.
- (i) Where deemed necessary by the manufacturer, provisions for continuous monitoring of structural integrity of track and columns may be required.
- (j) The pneumatic system shall include components to provide lubrication and moisture extraction where deemed appropriate by the designer.

5-13.201.10 Operator controls.

- (a) Operator controls shall be designed to be located within easy reach of the operator when that operator is in a position to observe the ride while it is in operation. An operator shall be in the immediate vicinity of the operating controls at all times when the public is admitted.

Exceptions:

1. On devices or rides designed to be operated by a passenger.
 2. When E-stops are accessible from the normal working position of the operator.
- (b) Operator control systems shall be designed to minimize inadvertent operation.
 - (c) Operator controls shall be identified in the English language as to their function.
 - (d) An amusement ride or device propelled so as to be theoretically capable of exceeding a safe operating speed

shall be provided with a speed governor. Governors having an adjustable speed setting shall be secured so as to be inaccessible to other than those who have been assigned access by the owner/operator so that the speed cannot be changed by other than those assigned.

5-13.201.11 Brakes.

- (a) Brake design shall provide sufficient capacity to satisfy the manufacturer's recommended operation parameters.
- (b) A block system shall be designed for those rides and devices where, by the ride design, it is necessary to prevent independent passenger-carrying units from occupying the same block section or zone of the ride.
- (c) Braking systems shall be designed to be energized systems that remain activated in the event of power failure.
- (d) Inspection or test requirements for braking devices shall be assessed and information provided by the manufacturer to the owner/operator, including method and interval. This shall include daily inspections required to be performed prior to carrying guests, if applicable. Inspections shall be reasonable and such that the owner/operator can reasonably be expected to perform or cause to be performed.
- (e) Operator monitored braking systems designed to be normally activated in the absence of the operator shall be considered by the designer.

5-13.201.12 Machine guards. Machine guards shall be designed to protect employees and guests from hazards associated with, but not limited to belts, chains and pulleys.

5-13.201.13 Fencing for amusement rides and devices. Fencing is not a mandatory requirement for all rides and attractions. Other suitable means of protection, such as architectural barriers, landscaping or operator control, may be used. Fences and gates of alternative dimensions may also be utilized to supplement operator control, when approved by the Building Official.

- (a) Fencing and gates, when installed, shall comply with the following:
 1. Fencing and gates shall form a vertical protective barrier not less than 42 inches high and shall be such that a 4-inch-diameter sphere cannot pass through any opening.
 2. Fencing and gates shall be designed and constructed to prevent overturning by spectators or riders.
 3. Where used, entrance, exit and loading gates shall open away from the ride or device unless equipped with a positive latching device.
 4. Fences and gates shall be designed and constructed to restrict spectator contact with the ride or device or rider contact with the fence or gates.

5-13.201.14 Automatic and manual safety devices. Automatic and manual safety devices shall be assessed and information provided by the manufacturer to the owner/operator as to inspection or test requirements, including method and interval. This shall include daily inspections to be performed

prior to carrying guests, if applicable. Inspections shall be reasonable and such that the owner/operator can reasonably be expected to perform or cause to be performed.

5-13.201.15 Pressurized fuel cylinders. All pressurized fuel cylinders shall be governed by a comprehensive engineering specification for maintaining all required certification.

SECTION 5-13.301 OPERATION PROCEDURES

5-13.301.1 Purpose. The purpose of this Section is to delineate requirements and to establish procedures relating to the operation of amusement rides and devices.

5-13.301.2 Manufacturer's responsibility. The manufacturer of an amusement ride or device shall provide, with delivery of each ride or device, documented, recommended operating instructions in the English language. These instructions shall include, but not be limited to, the following;

- (a) Description of the ride or device operation including the function and operation of its major components.
 1. Description of the motion(s) of the ride or device during operation.
 2. Description of the recommended passenger loading procedures during operation, including recommended seating, when applicable.
- (b) Recommended safety procedures and instructions, and information about safety equipment pertaining to patrons and ride or device operators.
 1. Maximum total passenger weight and maximum number of passengers by carrier unit or ride total.
 2. Description of the passenger restraint system, its recommended use and operation.
 3. Ride or device operator safety check; recommended visual or other inspections to be performed by ride or device operators prior to and during each ride or device cycle.
 4. Instructions to the patron; recommended information that should be made available to each patron of the ride or device.
 5. Recommendations for operational restriction relating to environmental conditions, such as wind, rain, extreme heat or cold, lightning, humidity, ice, etc.
- (c) Manufacturer's recommended ride or device operating procedures, including the location of ride or device operators.
 1. Description of the recommended, daily pre-opening inspection to be performed by ride or device operator(s) that is in addition to previously performed maintenance or other inspections.
 2. Description of the recommended ride or device operator(s) positions and functions.
 3. Description of the recommended series of steps to be followed in a definite order to complete the operation of the ride or device.

- (d) Manufacturer's recommended emergency procedures.
 1. Recommended evacuation procedures for the ride or device.
 2. Description of any emergency equipment that is provided with the ride or device, and its uses.
 3. Description of any emergency procedure made necessary by an interruption of power, and restart procedures, including the use of emergency power equipment, if provided with the ride or device.

5-13.301.3 Owner/operator's responsibility. The owner/operator of an amusement ride or device shall read and become familiar with the contents of the manufacturer's recommended operating instructions and specifications, when received as provided in this Section. In conjunction with the manufacturer, and based on these instructions and specifications, the owner/operator shall prepare an Operating Guideline. This procedure shall be made available to each operator of the amusement ride or device. The procedure (on a ride-by-ride basis) shall include, but not be limited to:

- (a) Specific ride or device operation policies and procedures with pertinent information from the manufacturer's instructions.
 1. Description of the ride or device operations.
 2. Duties of the specific assigned position of the ride or device operator.
 3. General safety procedures.
 4. Additional recommendations of the owner/operator.
- (b) Specific emergency procedures to be used in the event of an abnormal condition or an interruption of service.
- (c) The owner/operator shall provide training for each amusement ride or device operator. This training shall include, but not be limited to, the following, where applicable:
 1. Instructions on ride or device operating procedures.
 2. Instructions on specific duties of the assigned position.
 3. Instructions on general safety procedures.
 4. Instructions on emergency procedures.
 5. Demonstration of the physical ride or device operation.
 6. Supervised observation of the ride or device operator's physical operation of the ride or device.
 7. Additional instructions deemed necessary by the owner/operator.
- (d) The operator of each amusement ride or device shall conduct a daily pre-opening inspection of each ride or device prior to carrying passengers. This inspection shall include, but not be limited to, the following:
 1. Visual check of all passenger-carrying devices, including restraint devices and latches.

2. Visual inspection of entrances, exits, stairways and ramps.
3. Test of all communications equipment necessary for the operation of the ride or device.
4. The ride or device shall be appropriately operated, without passengers, to determine that it is functioning properly.

SECTION 5-13.401 MAINTENANCE PROCEDURES

5-13.401.1 Purpose. The purpose of this Section is to delineate requirements for the maintenance of amusement rides and devices.

5-13.401.2 Manufacturer's responsibility. The manufacturer of an amusement ride or device shall provide, with delivery of each ride or device, documented maintenance instructions in the English language. These instructions shall include, but not be limited to, the following:

- (a) Description of the ride or device operation including the function and operation of its major components.
- (b) Description of the designed motion(s) of the ride or device during operation.
- (c) Description of the recommended procedures for installation, setup, disassembly and transportation of an amusement ride or device, if appropriate.
- (d) Recommended lubrication procedures for the amusement ride or device.
 1. Recommended types and specifications of lubricant.
 2. Recommended frequency of lubrication.
 3. A lubrication drawing, chart or instruction showing the location of lubrication points.
 4. Recommended special method of lubrication, where applicable.
- (e) Description of the recommended daily, pre-opening maintenance inspections to be performed and identification of special care areas and recommended procedures for inspection and maintenance of these areas.
- (f) Description, including frequency, of recommended maintenance inspections and testing, other than daily pre-opening inspection.
 1. Recommended wear limits or tolerances where deemed necessary by the manufacturer.
 2. Recommended operational tests, along with minimum intervals for these tests to be performed, that will allow the owner/operator of the ride or device to determine whether a given ride or device is operating within recommended prescribed operational limits.
 3. Where applicable, recommended nondestructive testing along with appropriate acceptance criteria, including suggested frequency and identification of the parts or areas to be tested.

4. Tests recommended pursuant to this Section shall meet the following criteria:

- (aa) The tests shall have been performed satisfactorily by the manufacturer prior to the installation of the amusement ride or device.
- (bb) The test shall be one that the amusement ride or device, or element, can reasonably be expected to pass during the expected life of the amusement ride or device, or element, assuming recommended maintenance and operating procedures have been followed.
- (cc) The test shall be one that is reasonable, and that the owner/operator can reasonably be expected to be competent to perform or cause to be performed.
- (dd) Together, these tests shall provide a thorough evaluation of systems and components.
- (ee) Recommended specifications for the use, or re-use, of original and replacement fasteners, including torque requirements, where applicable. If appropriate, precautionary information shall be provided relating to the continued use of fasteners that have been loosened or retorqued.
- (ff) Age control and/or other special handling requirements for those components effected, such as O-rings, rubber parts, filters, etc.
- (gg) Schematics of electrical power, lighting, controls, and other systems, including location charts and manufacturer's troubleshooting guide, where applicable.
 - 1. Description of recommended maintenance procedures for electrical components.
 - 2. The name of the component manufacturer and appropriate identification number, specifications or both, shall be provided for electrical components used within the amusement ride or device.
 - 3. Each electrical component used within the amusement ride or device shall be assigned an individual identification number, symbol or code to facilitate its location and identity on the electrical schematics.
- (hh) Schematics of hydraulic and pneumatic systems, including recommended pressures, location of components, component, line and fitting identification, type

of fluid, location chart and manufacturer's troubleshooting guide.

- (ii) Description of recommended maintenance procedures for hydraulic and pneumatic systems and components.
- (jj) List of parts used in the assembly of the ride or device, giving component specification, location and orientation in the assembly, cross referenced to the schematics, or drawings providing equivalent information.
- (kk) Description of recommended assembly and disassembly techniques and procedures, pertaining to specific components, as deemed necessary by the manufacturer.
- (ll) Recommended restrictions and special procedures, lubricants, materials or equipment that may be necessary because of environmental conditions.
- (mm) Other recommendations known to the manufacturer and specific to certain serial numbered rides or devices.
- (nn) Maintenance bulletins or similar documents, originated by the manufacturer of the amusement ride or device after the initial instructions have been provided as described in this Section, shall be supplied to the known owner/operator of the amusement ride or device.
- (oo) Replacement parts for amusement rides and devices shall be obtained from the manufacturer of the amusement ride or device, or manufactured to meet the original specifications and drawings, meeting or exceeding the same quality and function of the original part(s), as provided for in ASTM F853.

5-13.401.3 Owner/operator responsibility.

- (a) The owner/operator of an amusement ride or device shall read and become familiar with the contents of the manufacturer's maintenance instructions and specifications when received, as provided in this Section. Based on the manufacturer's recommendations, each owner/operator shall implement a program of maintenance, testing and inspections providing for the duties and responsibilities necessary in the care of each amusement ride or device. This program of maintenance shall include a checklist to be made available to each person performing the regularly scheduled maintenance on each ride or device. This maintenance checklist (on a ride-by-ride basis) shall include, but not be limited to:
 - 1. Description of preventive maintenance assignments to be performed, including interval.
 - 2. Description of inspections to be performed, including interval.

3. Special safety instructions, where applicable.
 4. Any additional recommendations of the owner/operator.
- (b) The owner/operator of the amusement ride or device shall provide training for each person performing the regularly scheduled maintenance on the ride or device, pertaining to their assigned duties. This training shall include, but not be limited to, the following:
1. Instruction on inspection and preventive maintenance procedures, including identification of special care areas.
 2. Instruction on the specific duties of the assigned position.
 3. Instruction on general safety procedures.
 4. Demonstration of the physical performance of the assigned regularly scheduled duties and inspections.
 5. Supervised observation of the maintenance person's physical performance of their assigned, regularly scheduled duties and inspections.
 6. Additional instructions deemed necessary by the owner/operator.
- (c) Prior to carrying passengers, the owner/operator shall conduct or cause to be conducted a daily documented and signed pre-opening inspection, based on provided instructions, to ensure the proper operation of the ride or device. The inspection program shall include, but not be limited to, the following:
1. Inspection of all passenger-carrying devices, including restraint devices and latches.
 2. Visual inspection of entrances, exits, stairways and ramps.
 3. Functional test of all communication equipment necessary for the operation of the ride.
 4. Inspection or test of all automatic and manual safety devices, if applicable.
 5. Inspection or test of the brakes, including service brakes, emergency brakes, parking brakes and back stops, if applicable.
 6. Visual inspection of all fencing, guarding and barricades, if applicable.
 7. Visual inspection of the ride structure.
 8. The ride or device shall be appropriately operated, without passengers, to determine that it is functioning properly.
- (d) An amusement ride or device, or the specifically affected elements, shall be appropriately inspected and operated, without passengers, to determine that it is functioning properly following an unscheduled cessation of operation caused by:
1. Malfunction or significant adjustment;
 2. Mechanical, electrical or operational modification or;
 3. Environmental conditions that affected the operation or any combination of these listed elements.
- (e) Fastening holes exhibiting wear beyond specific limits shall be replaced or repaired in accordance with the manufacturer's recommendations.
- (f) Speed governing controls that become unsecured or require adjustment shall be resecured before operation of the ride or device is resumed.
- (g) The owner/operator shall maintain adequate records and as-built drawings to depict the current configuration of the ride or device.

SECTION 5-13.501 TESTING PERFORMANCE

5-13.501.1 Scope and use.

- (a) This Section covers the basic tests that shall be conducted on amusement rides and devices during prototype development, installation or erection, following major modifications, and during normal operation to determine that the performance of a given ride or device meets the manufacturer's specified design criteria.
- (b) This Standard is intended for the use of manufacturers, owners/operators, and those persons or agencies involved in the installation and operational testing of amusement rides and devices.

5-13.501.2 Development testing by the manufacturer. Where applicable, as determined by the manufacturer, the following test procedures shall be developed and performed on a prototype amusement ride or device in order that the appropriateness for use, of not only the parts, but the entire system of a newly designed ride or device, may be determined.

- (a) Procedures to verify maximum safe design loads:
1. Procedures to verify such design characteristics as relevant deflections, loads and forces that are placed on both the equipment and the passengers during operation of the ride or device.
 2. A procedure to determine operational limits and restart criteria due to environmental conditions.
 3. Procedures to allow the manufacturer to determine such factors as component variability and certification requirements of critical components.
 4. Any other procedures necessary to demonstrate a ride or device's appropriateness for its intended use.

5-13.501.3 Installation testing. This Subsection covers those tests relevant not only to installation, but also includes post-modification and major modifications. The original manufacturer or supplier of an amusement ride or device shall also provide, where applicable, the following standard testing guides:

- (a) **Materials testing.** Acceptable test procedures for the certification of all major structural components shall be provided. Where possible, this testing should be referenced to commonly accepted industry standards.

- (b) **Erection/modification acceptance testing.** Test procedures or criteria for the acceptance of such construction operations as welding and fastening shall be provided. Reference, where possible, should be made to currently accepted industry standards for this purpose.
- (c) **Performance acceptance testing.** Tests shall be developed and performed in order to ensure that the newly erected ride or device conforms to the original design criteria.

5-13.501.4 Operational testing.

- (a) The manufacturer of a ride or device shall develop specific operational tests along with minimum intervals for these tests to be performed that will allow the owner/operator of a ride or device to determine whether that ride or device is operating within prescribed operational limits.
- (b) All operational tests shall meet the following criteria:
 1. All tests shall have been satisfactorily performed by the manufacturer.
 2. The tests shall be such that the ride, device or element can reasonably be expected to pass during its expected design life, assuming recommended maintenance and operative procedures have been followed.
 3. All tests shall be reasonable and such that the owner/operator can reasonably be expected to be competent to perform or cause to be performed.
 4. Any operational test, including load testing performed on an amusement ride or device, shall be completely nondestructive in nature. Overload testing exceeding the previously stated limits shall be deemed inappropriate.
 5. Any installation or operational testing conducted on an amusement ride or device shall be accomplished within the rated limits of the information provided by the manufacturer.

5-13.501.5 Nondestructive testing (NDT). This Subsection pertains to the nondestructive testing of amusement ride and device components as recommended by the manufacturer. These tests shall be performed by a qualified NDT inspector in accordance with Practice E 543 or ASNT Recommended Practice SNT-TC-1A, or both. It is not intended to preclude any other schedule of NDT, inspection or testing.

- (a) NDT is the development and application of technical methods, such as radiographic, magnetic particle, ultrasonic, liquid penetrant, electromagnetic, neutron radiographic, acoustic emission, visual and leak testing, to examine materials or components in ways that do not impair the future usefulness and serviceability in order to detect, locate, measure and evaluate discontinuities, defects and other imperfections; to assess integrity, properties and composition; and to measure geometrical characters.
- (b) NDT shall be used to verify the integrity of components which due to their design, location, or installation,

or combination thereof, cannot be adequately evaluated by other means.

- (c) A schedule for testing on a given ride or device component shall be defined in terms of hours, days or other units of operation. The initial design shall be developed to expect a period between tests to be no more frequent than annually.
- (d) The manufacturer shall recommend components to be tested along with appropriate acceptance criteria. The manufacturer may recommend the test method, but shall not specify how the testing is to be conducted, except where certain procedures might adversely affect other components on the ride or device. Any changes or additions to these recommendations shall be communicated to all known owner/operators of the ride or device, and inspection agencies via manufacturer's bulletins. Tests shall meet the requirements of Subsections 5-13.501.4(b)1 through 5-13.501.4(b)3.
- (e) The manufacturer shall include in an appropriate section of the ride or device manual the list and location of components to be tested, recommending specific areas to test and the schedule by which they shall be tested in accordance with Paragraph (d).
- (f) Components found to have relevant indications that do not meet the acceptance criteria shall be replaced or reconditioned in accordance with Practice F 853.
- (g) Components found free of relevant indications that meet the acceptance criteria or have been reconditioned, shall be further tested at regular schedule in accordance with Paragraph (c).
- (h) Within a reasonable time following a request by an owner/operator or inspection agency, the manufacturer of an amusement ride or device whose manual does not contain testing recommendations shall either provide a component listing or statement that no NDT is recommended on the ride in accordance with the criteria outline of Paragraph (b). When a manufacturer's list or statement is not available, it may be compiled by a registered professional engineer or engineering agency, or by any qualified by training and experience to compile such a list or statement based upon the ride or device's specifications and history and using accepted engineering practices.
- (i) The owner/operator shall be responsible for implementing a program of testing based on the recommendations of this Section.

SECTION 5-13.601 PHYSICAL INFORMATION TO BE PROVIDED

5-13.601.1 Scope. This Section covers the minimum requirements for information that shall be provided to the owner/operator by the manufacturer of an amusement ride or device, prior to initiating operation of that ride or device with passengers.

5-13.601.2 Purpose. It is intended to provide the minimum information necessary for the proper identification, placement, erection and operation of each amusement ride or device.

5-13.601.3 Information requirements.

- (a) The information listed in this Subsection shall be either included or indicated as not applicable for all amusement rides and devices by the manufacturer.
- (b) **Serial numbers.** A manufacturer's issued unique identifying number or code affixed to the ride or device, or individual passenger carrying unit, as applicable, in a permanent fashion.
 - 1. **Nomenclature.** A manufacturer's issued unique identifying nomenclature for that specific ride or device, in English, including location of manufacturer by city, state and country. This shall be provided in name plate form, if applicable.
- (c) **Ride model number.** A manufacturer's issued unique identifying number or code assigned to each manufactured type of ride having the same structural design or components.
- (d) **Date of manufacture.** The date (month and year) determined by the manufacturer that the given ride or device met the required construction specifications.
- (e) **Trailing information.** Sufficient information shall be provided with each portable ride or device, or element, if applicable, to enable handling and transportation without damage.
- (f) **Static information.** The following information shall be provided for the amusement ride or device when it is in a nonoperational state with no passengers: height, width, length (or diameter) and weight.
- (g) **Dynamic information.** The following information shall be provided for the amusement ride or device when it is in an operational state: height, width, length (or diameter) and weight.
- (h) **Ride speed.** Minimum and/or maximum acceptable speed or rate of acceleration, deceleration or jerk, of the ride or device expressed in units appropriate for that ride or device. For example: revolutions per minute, time duration for travel over a specified or known distance, feet per second, feet per second per second, etc., in conventional U.S. units of measurements.
- (i) **Direction of travel.** When the proper direction of travel is essential to the design operation of the ride, the manufacturer shall designate the direction of travel, including reference point, for this designation.
- (j) **Power requirements.**
 - 1. **Electrical.** Total electrical power required to operate the ride or device designated in hertz, watts, volts and amperes, including minimum and maximum voltage limits, as well as emergency requirements, if applicable.
 - 2. **Mechanical.** Minimum horsepower necessary to operate the ride or device properly.

(k) Load distribution per footing.

- 1. Maximum static loading of each footing of an amusement ride or device; and
- 2. Maximum dynamic loading of each footing of an amusement ride or device.

(l) Passenger capacity.

- 1. Maximum total passenger weight, per passenger position and per ride.
- 2. Maximum total number of adult or child passengers, per passenger position and per ride.

(m) Ride duration. The actual time the ride is in operation or a passenger is exposed to the elements of the ride functions, including passenger restrictions to maximum exposure time shall be included.

(n) Recommended balance of passenger loading or unloading. When passenger distribution is essential to the proper operation of the ride or device, the appropriate loading and unloading procedure, with respect to weight distribution, shall be provided.

(o) Recommended passenger restrictions. Where applicable, any recommended passenger limitations such as, but not limited to, height, weight, passenger placement or any other appropriate restrictions.

(p) Environmental restrictions. Recommendations for operational restrictions relating to environmental conditions such as, but not limited to, wind, rain, extreme heat or cold, and other weather-related factors, such as lightning, humidity, ice, etc.

(q) Fastener schedule. A manufacturer's issued schedule for the correct grade, torque, placement and re-use of all fasteners used in the assembly or erection, or both, of the ride or device.

SECTION 5-13.701 INSPECTION

5-13.701.1 Scope. This Section defines inspections of amusement rides and devices to be provided during prototype development, manufacturing, installation or erection, following major modification or overhaul, and during operation and maintenance periods.

5-13.701.2 Periodic inspections.

- (a) The owner shall cause periodic inspections to be made of any device regulated by this Standard.
- (b) The Building Official may require inspections to be made as considered necessary to assure safe operation of the device or equipment.
- (c) The Department of Building and Safety shall make appropriate inspections during the installation, modification and testing of all amusement rides and devices, and no amusement ride or device shall be issued a Certificate of Occupancy until final approval by the Building Official.

5-13.701.3 Quality assurance program. Manufacturer's responsibility:

- (a) The manufacturer of an amusement ride or device shall have a written quality assurance program for use in conjunction with the design, manufacture, construction, modification or reconditioning of the amusement ride or device.
- (b) Quality assurance documents, that is, material certifications, test reports and inspection reports, shall be retained for the useful life of the amusement ride or device.
- (c) The manufacturer of an amusement ride or device shall provide the owner/operator with a written inspection procedure to be delivered with the ride or device. The document shall outline those inspections as contained in the maintenance and operation sections of this Standard.
 - 1. Any changes in the previously prescribed procedure, deemed essential by the manufacturer to be made after delivery, shall be communicated to all known owner/operators.
- (d) All inspections recommended shall meet the following criteria:
 - 1. Inspections shall be such that they shall have been satisfactorily performed by the manufacturer.
 - 2. Inspections shall be ones in which the ride or device, or element, can reasonably be expected to pass during the expected design life of the ride, device or element, assuming that recommended maintenance procedures have been followed.
 - 3. Inspections shall be reasonable and such that the owner/operator can reasonably be expected to be competent to perform or cause to be performed.
- (e) Upon notification from an owner/operator of an incident involving a critical component, the manufacturer of an amusement ride or device shall promptly evaluate this information and disseminate his findings to that owner/operator and, in addition, shall make any pertinent recommendations to all other known owner/operators of rides or devices of the same nomenclature, or sharing comparable features that might contribute to or be effected by those factors indicated in the incident.
 - 1. Owner/operator responsibilities:
 - (aa) Owner/operators of amusement rides or devices shall have an inspection program consistent with the inspections outlined in the maintenance and operations sections of this Standard; *Standard Practice for Operation Procedures*, ASTM F770; and *Standard Practice for Maintenance Procedures*, ASTM F853.
 - (bb) Inspection documents deemed appropriate by the owner/operator shall be maintained according to the procedures

outlined in the maintenance and operations sections of this Standard.

- (cc) The owner/operator of an amusement ride or device shall promptly notify the manufacturer and the Department of Building and Safety of an incident, failure or malfunction, which, in his judgment, seriously affects the continued proper operation of the ride or device and is information of which the manufacturer and the Department of Building and Safety should be aware.

SECTION 5-13.801 MANUFACTURER'S QUALITY ASSURANCE PROGRAM

5-13.801.1 Scope. This Section defines the minimum requirements necessary for establishment of a written Quality Assurance Program for an amusement ride and device manufacturer.

5-13.801.2 Drawing control procedure. A procedure shall be in effect to assure that appropriate drawings, revisions and related documents are used for each project.

5-13.801.3 Material control procedure. A procedure shall be in effect to assure that all materials, processes and components, including raw materials, are in accordance with the engineering specifications.

- (a) This procedure shall provide the purchasing agent with all the information required to order appropriate material.
- (b) A receiving procedure shall be in effect so that incoming material is checked against the purchasing specifications.
- (c) A procedure shall be in effect so that material in stock can be properly identified for future use.
- (d) Documentation on any material, process or components certified shall be maintained for reference.

5-13.801.4 Inspection.

- (a) A procedure shall be in effect so that appropriate inspections are made on manufactured parts and subassemblies to ensure conformance to engineering specifications.
- (b) A procedure shall be in effect so that appropriate inspections are made on purchased components.
- (c) A procedure shall be in effect so that completed units are inspected prior to delivery.
- (d) Nonconforming components shall be identified and evaluated for disposition as follows:
 - 1. Reworked components shall be re-inspected in accordance with this practice prior to use.
 - 2. A component not suitable for use shall be altered or disposed of to avoid accidental use.
- (e) In some cases, a component may be determined to be "acceptable as is" or "as modified" after further evaluation.

tion. In such cases, appropriate review, acceptance and documentation shall be a requirement.

5-13.801.5 Welding. Welding of critical components shall be in accordance with AWS, ASME or other equivalent standards and be performed by appropriately certified welders.

- (a) A procedure shall be in effect to identify critical components for the manufacturing shop.
- (b) A procedure shall be in effect to maintain documentation on certification of welders.

EPCOT STANDARD 6-1

FIRE TESTS AND FIRE-RESISTIVE RATING OF BUILDING CONSTRUCTION

PART 1 TESTING FOR FIRE RESISTANCE

6-1.101 Testing criteria.

- (a) Materials and assemblies of materials and systems used in building construction as set forth in this Code as adopted by the District shall be tested in accordance with the procedures specified in ASTM E119, *Standard Method of Fire Test of Building Construction and Materials*.
- (b) Terms relating to fire tests of building construction and materials have the meanings specified in ASTM E176, *Standard Terminology Relating to Fire Standards*.

PART 2 PERFORMANCE REQUIREMENTS FOR BUILDING COMPONENTS UNDER EXPOSURE TO FIRE

6-1.201 Performance criteria. The kind and minimum thickness of fire protection and rated time periods of fire resistance of building components and assemblies shall be as set forth in tests made by a recognized independent laboratory in accordance with Part 1, or shall be determined by the Building Official based upon calculations set forth in Section 311.

EPCOT STANDARD 7-7

FIRE-RETARDANT ROOF COVERINGS

SECTION 7-7.101 ADMINISTRATIVE REQUIREMENTS

7-7.101.1 Scope.

- (a) Roof coverings hereafter constructed, applied, altered or repaired shall comply with the requirements of this Code and Standard.
- (b) Not more than 25 percent of the roof covering of any building or structure shall be replaced in any 12-month period, unless the entire roof covering is made to conform to the requirements of this Code and Standard.
- (c) Roof coating systems shall be designed to extend the useful life expectancy of existing roof assemblies, and stop or prevent moisture intrusion into existing roof assemblies, including all components of the existing roof assemblies, such as pitch pans, flashing, through-roof penetrations, and attachments and parapet wall surfaces.

7-7.101.2 Permits. A permit shall be required for construction, application, alteration or repair of roofs in accordance with the requirements of Chapter 3. Application for permit shall be accepted only from persons or firms qualified to perform the work.

7-7.101.3 Inspections. Inspections shall be made as specified in Subsection 306.2, and in accordance with the following requirements:

- (a) On new roof construction, where the sheathing is exposed from below and, for architectural appearance, the roofing nails are not driven through the sheathing, the permit holder shall notify the Building Official before the tin capping is completed and an inspection shall be made before the roof is mopped or covered.
- (b) When replacing roof coverings on existing buildings, the permit holder shall notify the Building Official before capping is completed and an inspection shall be made before the roof is mopped or covered.
- (c) When applying tile roofing, the permit holder shall notify the Building Official before the roof covering is completed and an inspection shall be made during the process of laying the tile.
- (d) When applying coating systems over an existing roof, the permit holder shall notify the Building Official at completion of the system installation for inspection.

7-7.101.4 Fire classification of roof covering. Roof assemblies shall be divided into the classes defined below. Class A, B and C roof assemblies and roof coverings required to be listed by this Section shall be tested in accordance with ASTM E108 or UL 790. In addition, fire-retardant-treated wood roof coverings shall be tested in accordance with ASTM D2898.

- (a) **Class A roof assemblies.** Class A roof assemblies are those that are effective against severe fire test expo-

sure. Class A roof assemblies and roof coverings shall be listed and identified as Class A by an approved testing agency.

Exception: Brick, masonry, slate, clay or concrete roof tile, exposed concrete roof deck, ferrous or copper shingles or sheets are considered to meet Class A roof covering provisions without testing.

- (b) **Class B roof assemblies.** Class B roof assemblies are those that are effective against moderate fire test exposure. Class B roof assemblies and roof coverings shall be listed and identified as Class B by an approved testing agency.

Exception: Metal sheets and shingles are considered to meet Class B roof covering provisions without testing.

- (c) **Class C roof assemblies.** Class C roof assemblies are those that are effective against light fire test exposure. Class C roof assemblies and roof coverings shall be listed and identified as Class C by an approved testing agency.
- (d) **Nonclassified roofing.** Nonclassified roofing is approved material that is not listed as a Class A, B or C roof covering.
- (e) **Fire-retardant-treated wood shingles and shakes.**

1. **Fire testing.** When testing wood shingles and shakes in accordance with ASTM E108 (including the rain test) and ASTM D2898, the fire tests shall include the intermittent flame test, spread of flame test and burning brand test; additionally, at the conclusion of the rain test, test panels shall be subjected to the intermittent flame test, burning brand test and flying brand test.

2. **Treatment.** Fire-retardant-treated wood shakes and shingles shall be treated by impregnation with chemicals by the full-cell vacuum-pressure process, in accordance with AWPA C1. Each bundle shall be marked to identify the manufactured unit and the manufacturer, and shall also be labeled to identify the classification of the material in accordance with the testing required in Paragraph 1 (Class B or C), the treating company and the quality control agency.

7-7.101.5 Criteria.

- (a) Design of roof decks and supporting structural members shall be as specified in Chapters 7 and 9.
- (b) Materials used for roof coverings shall comply with the Standards listed in Table 7-7.1.

**TABLE 7-7.1
REFERENCED STANDARDS FOR ROOF COVERINGS**

Standard	Author and Designation
Test for Wind-Uplift Resistance of Roof Assemblies	UL 580-06
Built-Up Roofs: Mineral aggregate—Specification	ASTM D1863-06
Asphalt for use in built-up roof covering	ASTM D312-00
Asphalt base sheet for use in built-up roof covering	ASTM D2626-04
Asphalt base emulsions for use as protective coatings for built-up roofs	ASTM D2939-03
Bituminous and other organic materials for roofing, waterproofing and related uses	ASTM D1079-10
Standard test methods for fire tests of roof coverings	ASTM E108-07a
Composition roofing: Composition roofing—Fire tests	UL 790-04
Composition roofing—Specifications	UL 55A-04
Shingles: Slate shingles—Specification	ASTM C406-06e01
Wood shingles and handsplit shakes—Grading—Packing	CSSB-97
Standard test methods for accelerated weathering of fire-retardant-treated wood for fire testing	ASTM D2898-04
Wire: Brass Wire—Specification	ASTM B134-08
Aluminum alloy bars, rods and wire—Specification	ASTM B209-06
Wrought copper and copper alloy—Specification	ASTM B250/250 M-07

SECTION 7-7.201 IDENTIFICATION

7-7.201.1 All material.

- (a) All roofing material shall be delivered in the original package bearing the manufacturer's label.
- (b) The following requirements shall apply to specific materials and shall supplement, but shall not supersede, the requirements in the Standards of references listed in Table 7-7.1.
 1. **Built-up roofing.** Each package of felt, cement and base-ply combination or cap sheets shall bear the label of an approved testing laboratory having a service for inspection of material and finished products during manufacture.
 2. **Slate shingles.** Slate shingles shall bear the label of an approved inspection bureau or agency certifying compliance with ASTM C406. (See Table 7-7.1.) Ribbed or otherwise faulty slate shingles shall not be used.
 3. **Composition shingles.** Packages of composition shingles shall bear the label of an approved testing laboratory having a service for inspection of

material and finished products for Class A, B or C roofing.

4. **Prepared roofing.** Each package of prepared roofing shall bear the label of an approved testing laboratory having a service for inspection of material and finished products during manufacturing for Class A, B or C roofing.
5. **Wood shingles.** Each bundle of wood shingles for roofs shall bear the label of an approved inspection bureau or agency certifying compliance with the U.S. Bureau of Standards CS-31.
6. **Handsplit wood shakes.** Each bundle of wood shakes for roofs shall be of Red Cedar or Redwood and shall bear the label of an approved inspection bureau or agency certifying compliance with the *Standard Grading and Packing Rules* of the Cedar Shake and Shingle Bureau.

SECTION 7-7.301 FASTENINGS

7-7.301.1 Criteria. Fastenings for specific types of roof coverings shall be required as listed in Table 7-7.1, and shall comply with the following requirements:

- (a) **Composition roofs.** Nails for composition roofs shall be not smaller than 12 gage, with heads not less than a $\frac{3}{8}$ -inch diameter for shingle application, and $\frac{7}{16}$ -inch diameter for built-up roofs, and shall be long enough to penetrate the sheathing $\frac{3}{4}$ inch or through the thickness of the sheathing, whichever is less. Smaller size nail-heads may be used when metal discs are used with them. Exposed nails and shingle nails shall be corrosion resistant.
- (b) **Wood shingles.** Nails for wood shingles shall be corrosion resistant, not less than 14 $\frac{1}{2}$ gage and shall be long enough to penetrate the sheathing $\frac{3}{4}$ inch or through the thickness of the sheathing.
- (c) **Wood shakes.** Nails for wood shakes shall be the same as required for wood shingles.
- (d) **Cement shingles.** Nails for cement shingles shall be corrosion resistant, not less than 11 gage and shall be long enough to penetrate the sheathing $\frac{3}{4}$ inch or through the thickness of the sheathing.
- (e) **Slate shingles.** Nails for slate shingles and clay or concrete tile shall be corrosion resistant, not less than 11 gage and shall be long enough to penetrate the sheathing $\frac{3}{4}$ inch or through the thickness of the sheathing. Approved tiles of clay or concrete designed to be held in place by lugs engaging battens may be installed when approved by the Building Official.
- (f) **Tile (clay, concrete or slate).** Attaching wire for slate shingles and clay or concrete tile shall be not less than 14 gage complying with the requirements of Table 7-7.1. Nails for clay or concrete tile shall be as required for slate shingles.

SECTION 7-7.401 APPLICATION OF MATERIALS

7-7.401.1 Cement shingles and sheets.

- (a) Cement roofing shall be applied in an approved manner. Cement roofing shall have an underlay of not less than 15-pound felt, applied as required for a base sheet. The underlay may be omitted where the cement shingles or sheets are applied over an existing roof covering.
- (b) Cement roofing shall not be installed on a roof having a slope of less than 3 inches in 12 inches, except as approved by the Building Official.
- (c) Corrugated cement roofing not less than $\frac{5}{16}$ inch thick may be used where 24-gage galvanized sheet corrugated steel is permitted.
- (d) Roof valley flashing shall be the same as required for wood shakes.

7-7.401.2 Built-up roofs.

- (a) Built-up roofing shall be applied only to solid surface roofs.
- (b) Base sheets shall be cemented, spot-mopped or strip-mopped to a nonnailable deck as required for the type of deck, using not less than 20 pounds of hot asphalt for solid mopping, 10 pounds for spot or strip-mopping, or not less than 2 gallons of cold bituminous compound in accordance with the manufacturer's published specifications or 30 pounds of hot coal tar pitch per roofing square.
- (c) Successive layers shall be cemented to the base sheets using not less cementing material than as specified for solidly cemented base sheets.
- (d) Base sheets shall be nailed to nailable decks, using not less than one nail per $1\frac{1}{2}$ square foot. Nails shall be as required in the manufacturer's specifications for the type of deck.
- (e) Mineral aggregate surfaced roofs shall be surfaced with not less than 50 pounds of hot asphalt or other cementing material in which is embedded not less than 300 pounds of gravel or other approved surfacing material, or 250 pounds of gravel slag per roofing square. Mineral aggregate shall conform to the requirements of Table 7-7.2.
- (f) Cap sheets shall be cemented to the base sheets using not less cementing material than as specified for solidly cemented base sheets.
- (g) For high melt types, hot asphalt shall be applied at a temperature of not less than 375°F, nor more than 450°F, and shall not be heated to a temperature above 475°F. Low melt types shall not be applied at a temperature of less than 350°F, nor more than 400°F.
- (h) Coal tar pitch shall not be heated to a temperature above 375°F.

TABLE 7-7.2
SIEVE ANALYSIS OF AGGREGATES APPROVED
FOR USE IN MINERAL-SURFACED ROOFING

	PERCENTAGE OF AGGREGATE PASSING SIEVE EMBEDMENT COAT	PER ROOFING SQUARE
Sieve Size	60-Pound	50-Pound
$\frac{5}{8}$ inch	100	100
$\frac{1}{2}$ inch	90 – 100	100
$\frac{3}{8}$ inch	25 – 60	90 – 100
$\frac{1}{4}$ inch	0 – 10	30 – 70
No. 4	0 – 2	0 – 10
No. 8	—	0 – 4
No. 10	—	0 – 1
No. 20	0 – 0.5	0 – 0.5

7-7.401.3 Composition shingles.

- (a) Composition shingles shall be applied only to solidly sheathed roofs, except when applied over existing wood shingle roofs as approved by the Building Official.
- (b) Composition shingles shall be fastened according to the manufacturer's printed instructions, and as required in Subsection 7-7.301.1(a).
- (c) Composition shingles shall not be installed on a roof having a slope of less than 4 inches in 12 inches, except as approved by the Building Official.
- (d) Composition shingle roofs shall have an underlay of not less than 15-pound felt, applied as required for a base sheet. The underlay may be omitted over existing roofs, or where the roof slope is more than 7 inches in 12 inches or where shingles are laid not less than three thicknesses at any point.
- (e) Roof valley flashing shall be the same as required for wood shingles, or shall be of laced composition shingles, applied in an approved manner, with an underlay of not less than 30-pound felt extending 10 inches from the centerline each way or, shall be two layers of 90-pound mineral surfaced cap sheet cemented together with the bottom layer not less than 12 inches wide laid face down and the top layer not less than 24 inches wide laid face up.

7-7.401.4 Metal roofing.

- (a) Metal roofing exposed to the weather shall be corrosion resistant.
- (b) Flat sheets or shingles of metal shall be applied only to solidly sheathed roofs and shall be applied as approved by the Building Official and in accordance with the manufacturer's specifications.
- (c) Corrugated or ribbed steel shall not be less than 30 gage galvanized sheet.

- (d) Flat steel sheets shall not be less than 30 gage galvanized sheet.
- (e) Flat nonferrous sheets and shingles shall be not less than 28 B & S gage.
- (f) Other ferrous sections or shapes shall be galvanized sheets not less than 28 gage. Other nonferrous sections or shapes shall be not less than 25 B & S gage.
- (g) Corrugated sheets or other shaped sheet sections shall be designed to support the required live load between supporting members.
- (h) Ferrous sheets or sections shall comply with Section 1009.
- (i) Metal shingles shall not be installed on a roof having a slope of less than 3 inches in 12 inches, except as approved by the Building Official.
- (j) Metal shingles shall be applied as required for a base sheet over an underlay of not less than 30-pound felt.

7-7.401.5 Slate shingles.

- (a) Slate shingles shall be applied in an approved manner, and shall be securely fastened with corrosion-resistant nails or corrosion-resistant nails and wire. Fastenings shall comply with Subsection 7-7.301.1(e) and Table 7-7.1.
- (b) Slate shingle roofs shall have an underlay of not less than two layers of 15-pound felt or one layer of 30-pound felt, applied as required for a base sheet.
- (c) Roof valley flashing shall be the same as required for wood shakes.

7-7.401.6 Tile or clay and concrete.

- (a) All roof tile shall be securely fastened with corrosion-resistant nails or nails and wire, or other approved method. Fastenings shall comply with Subsection 7-7.301.1(f) and Table 7-7.1.
- (b) Tile shall not be installed on a roof having a slope of less than 3 inches in 12 inches, except as approved by the Building Official.
- (c) Tile with projecting anchor lugs at the bottom of the tiles shall be held in position by means of 1-inch by 2-inch wood strip, treated to resist moisture deterioration, nailed to the roof sheathing over the underlay or by other approved method.
- (d) Tile roofs shall have an underlay of not less than two layers of 15-pound felt or one layer of 30-pound felt, applied as required for a base sheet.
- (e) Roof valley flashing shall be the same as required for wood shakes.

7-7.401.7 Wood shingles.

- (a) Shingles may be applied to roofs with solid or spaced sheathing. The spaced sheathing shall be spaced not more than 4 inches clear, nor more than the width of the sheathing board. Spaced sheathing shall be not less than 1 inch by 3 inches nominal dimensions.
- (b) Shingles shall be laid with a side lap of not less than 1½ inches between joints in adjacent courses and ½ inch in alternate courses. Spacing between shingles shall be not

less than ¼ inch, nor more than ⅜ inch. Each wood shingle shall be fastened to the sheathing with two nails only and in accordance with the requirements of Subsection 7-7.301.1(b) and Table 7-7.1.

- (c) Shingles shall not be installed on a roof having a slope of less than 4 inches in 12 inches unless they are installed over an underlay of not less than 15-pound felt, applied as required for a base sheet, except as approved by the Building Official.
- (d) Roof valley flashing shall be corrosion-resistant galvanized sheet metal not less than 28 gage and shall extend at least 8 inches from the centerline each way and shall have a splash diverter rib not less than ¾ inch high at the flow line, formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches.
- (e) Weather exposure shall not exceed the maximum set forth in Table 7-7.3. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof.

7-7.401.8 Handsplit wood shakes.

- (a) Wood shakes shall conform to the requirements of the Cedar Shake and Shingle Bureau, and shall be tapered and nontapered pieces of Red Cedar or Redwood of random widths, ranging from 4 inches to 14 inches, and shall be one of the following three types:
 1. Handsplit and resawn; tapered and having one sawed and one split face, 18 inches, 24 inches or 32 inches long.
 2. Taper-split; tapered and having both split faces 24 inches long, or shall be accompanied by descriptive certificate identifiable as to shipment.
 3. Straight split; nontapered and with both faces split; 18 inches or 24 inches long.
- (b) Minimum butt thickness shall be ½ inch.
- (c) Shakes may be applied to roofs with solid or spaced sheathing. Spaced sheathing shall be spaced not more than 4 inches clear width, nor more than the width of the sheathing board. Spaced sheathing shall be not less than 1-inch by 4-inch nominal size.
- (d) Shakes shall be laid in straight or staggered courses. Shakes shall be laid with a side lap of not less than 1½ inches between joints in adjacent courses. Edges shall be parallel within 1 inch. Spacing between shakes shall be not more than ½ inch.
- (e) Each wood shake shall be fastened to the sheathing with two nails only. Nails shall be as required for wood shingles in Subsection 7-7.301.1(b) and Table 7-7.1. The starter course at the eaves shall be doubled and the bottom or first layer may be either 15-inch or 18-inch wood shakes or wood shingles. For the final course at the ridge, either 15-inch or 18-inch shakes may be used.
- (f) Shakes shall be laid with not less than 18-inch-wide strips of not less than 30-pound felt, applied as required for a base sheet, and when approved by the Building Official.

- (g) Roof valley flashing shall be corrosion-resistant galvanized sheet metal not less than 28 gage and shall extend not less than 11 inches from the centerline each way. A splash diverter rib not less than 1 inch high at the flow line shall be provided, formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches.
- (h) Weather exposures shall not exceed those set forth in Table 7-7.3. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof.

TABLE 7-7.3
WEATHER EXPOSURE AND ROOF PITCH

	EXPOSURES		ROOF PITCH	
	Length	Grade	3:12 ^a to less than 4:12 pitch	4:12 ^a pitch & steeper
Shingles	16 inch	No. 1	3 ³ / ₄ "	5"
		No. 2	3 ¹ / ₂ "	4"
		No. 3	3"	3 ¹ / ₂ "
	18 inch	No. 1	4 ¹ / ₄ "	5 ¹ / ₂ "
		No. 2	4"	4 ¹ / ₂ "
		No. 3	3 ¹ / ₂ "	4"
	24 inch	No. 1	5 ³ / ₄ "	7 ¹ / ₂ "
		No. 2	5 ¹ / ₂ "	6 ¹ / ₂ "
		No. 3	5"	5 ¹ / ₂ "
Shakes	Length		Exposure and Pitch	
	18 inch 24 inch		8 for 4:12 ^a and steeper 10" for 4:12 ^a and steeper pitch ^b	

a. Minimum roof slope.

b. Maximum exposure for 24-inch by ³/₈-inch handsplit shakes is 7¹/₂ inches.

EPCOT STANDARD 7-8

APPLICATION OF VENEER

SECTION 7-8.101 ADMINISTRATIVE REQUIREMENTS

7-8.101.1 Scope.

- (a) This Standard specifies methods of application of veneer in or on buildings hereafter constructed, erected, altered or repaired in the District, in accordance with this Code.
- (b) The term “veneer” shall have the meanings specified in Subsection 710.5.
- (c) This Standard supplements, but does not supersede, the requirements of this Code. Where there is a conflict between this Code and Standard, the requirements of this Code shall apply.

SECTION 7-8.201 VENEER OF MASONRY UNITS

7-8.201.1 Design. Design of veneer constructed of masonry units shall conform to the requirements of Chapters 7 and 10, and to the requirements of this Standard.

7-8.201.2 Materials. Masonry units, mortar, grout and attachments shall conform to the requirements of Section 1006.

7-8.201.3 Anchorage.

- (a) Masonry veneer shall be attached to the supporting wall with corrosion-resistant metal ties capable of resisting a horizontal force equal to twice the weight of the veneer.
- (b) Veneer ties shall be not less than 6 U.S. gage steel wire. Ties shall be spaced not more than 24 inches apart horizontally, nor more than 12 inches apart vertically. Corrugated sheet metal ties of not less than 22 U.S. gage steel wire may be used, with the same spacing as for steel wire ties, when approved by the Building Official.
- (c) Where veneer is applied to wood framing, ties shall be fastened through the sheathing into the studs.

7-8.201.4 Setting.

- (a) Masonry veneer shall be placed 1 inch clear of the backing; and when backing is of masonry, this space shall be solidly grouted.
- (b) When veneer is placed on wood framing, a weather-proof covering of asphalt-saturated felt or equivalent weighing not less than 15 pounds per square (100 square feet) shall be applied over solid sheathing. The 1-inch space between the sheathing and veneer need not be grouted.

7-8.201.5 Support. The weight of masonry veneer shall be supported on footings or other noncombustible structural supports, spaced not more than 12 feet vertically above a point 20 feet above the adjacent ground elevation. Veneer above openings shall be supported on lintels of noncombustible material.

Exceptions:

1. The weight of the masonry veneer attached to wood frame walls above the second floor shall be supported entirely on footings, and when placed above openings it shall be carried to the footings on non-combustible construction.
2. Flagstone and similar veneer shall be installed as specified for masonry, except when an alternative design is approved by the Building Official.

SECTION 7-8.301 VENEER OF NONSTRUCTURAL UNITS

7-8.301.1 Installation. Nonstructural materials used as veneer for walls shall comply with the requirements of Chapter 7 and this Standard.

7-8.301.2 Anchorage. Nonstructural material used as veneer shall be anchored to the supporting wall by corrosion-resistant metal ties of not less than 9 U.S. gage steel wire and shall be spaced not more than 12 inches apart horizontally and vertically.

Exception: Approved units of flat tile or terra cotta not more than 1 inch thick, with scored surfaces, may be cemented to masonry or concrete walls. Such units may be cemented to exterior grade plaster with a specially mixed Portland cement mortar having a bond to withstand a shearing stress of 50 pounds per square inch (psi), when approved by the Building Official. The mortar shall be mixed in accordance with Section 1006.

7-8.301.3 Terra cotta (ceramic) veneer.

- (a) Buildings may have a veneer of slabs of terra cotta not more than 72 square inches in superficial area.
- (b) Terra cotta veneer shall not be considered as part of the thickness of the wall.
- (c) Walls to which terra cotta veneer is applied shall be rigid and free from oil. Immediately before installation, the backing wall shall be cleaned by wire brushing to assure adhesion of the veneer.
- (d) Terra cotta veneer may be attached to a backing wall, either with metal anchors or by adhesion only, without anchors.
- (e) If anchored, the terra cotta veneer shall be not less than 1¼ inches thick; shall have key webs on the back thereof, and shall be tied to the backing wall with substantial corrosion-resistant metal anchors, not less than 6 U.S. gage steel wire in horizontal bed joints on about 12-inch centers and not more than 18-inch centers. Veneer ties shall support twice the full weight of the veneer in tension. The facing shall be set with back of terra cotta spaced not less than 1½ inches from the face of the backing wall and the space shall be filled

solidly with grout of Portland cement mortar and top gravel in proportion of not less than 1 to 6. Just before setting, the backing wall and the ceramic facing shall be drenched with clean water and shall be damp when grout is poured.

- (f) If not anchored, the terra cotta veneer shall be not more than 1 inch thick with units not more than 30 inches in any dimension, and with not more than 600 square inches of superficial area. The veneer shall have corrugations or vertical scoring on the back. Immediately before setting, each piece of terra cotta shall be soaked in clean water for at least 1 hour, and the surface of the backing wall shall be saturated with water applied through a hose nozzle at a pressure of not less than 25 psi. A brush coat of neat Portland cement and water shall then be applied both to the backing and to the back side of the terra cotta veneer. Mortar shall average $\frac{3}{4}$ -inch thickness.

- (g) Proportions of the mortar used for terra cotta veneer shall be as follows:

High calcium slaked lime putty, screened and aged at least 20 days, containing not more than 4 percent magnesium oxide	$\frac{1}{2}$ cubic foot
Clear, sharp siliceous sand	4 cubic feet
Ammonium stearate paste or approved equal	1 quart
Approved Portland cement	1 cubic foot

Half of the mortar shall be applied to the piece of terra cotta and half to the backing immediately before the setting. Pieces disturbed after having been tapped into place shall be removed, after which additional mortar shall be applied and the piece reset. A unit shearing strength between backing and facing of not less than 50 psi shall be developed.

7-8.301.4 Marble veneer. Marble veneer shall be anchored to the backing by ties capable of resisting a horizontal force equal to twice the weight of the marble veneer without dependence on the use of plaster of paris or other adhesives, and as approved by the Building Official.

7-8.301.5 Ferro enamel panels. Ferro enamel panels and similar veneer shall be fastened to the wall with corrosion-resistant metal anchors, and in accordance with the manufacturer's recommendations and as approved by the Building Official.

SECTION 7-8.401 GLASS VENEER

7-8.401.1 Design. Glass veneer shall be designed in accordance with Section 902, and shall be installed in accordance with Chapter 7 and the following requirements.

7-8.401.2 Dimensions. Glass veneer units shall be not less than $\frac{11}{32}$ inch thick. No unit shall be more than 10 square feet in area when 15 feet or less above the grade directly below,

nor more than 6 square feet when more than 15 feet above the grade directly below.

7-8.401.3 Attachment.

- (a) Glass veneer units shall be attached to the backing with approved mastic cement and corrosion-resistant ties, and shall be supported on shelf angles in accordance with the provisions of this Subsection.

1. When more than 6 feet above grade, veneer shall be supported by shelf angles. Ties shall be used in both horizontal and vertical joints.
2. Below a point 6 feet above grade, glass veneer shall rest on shelf angles. Veneer shall not be supported on construction that is not an integral part of the wall; and over sidewalks, veneer shall be supported on a shelf angle not less than $\frac{1}{4}$ inch above grade.
3. All edges of glass veneer shall be ground.

- (b) The mastic shall cover not less than one-half the area of the unit after the unit has been set in place and shall be not less than $\frac{1}{4}$ inch, nor more than $\frac{1}{2}$ inch thick. The following requirements for the use of mastics shall apply:

1. The mastic shall be insoluble in water and shall not lose its adhesive properties when dry.
2. Absorbent surfaces shall be sealed by a bonding coat before the mastic is applied. The bonding coat shall be cohesive with the mastic.
3. Glass veneer surfaces to which mastic is applied shall be clean and uncoated.
4. Space between edges of glass veneer shall be filled uniformly with an approved jointing compound.

- (c) Shelf angles shall be of corrosion-resistant material capable of supporting four times the weight of the supported veneer. The shelf angles shall be spaced vertically in alternating horizontal joints, but not more than 3 feet apart. Shelf angles shall be secured to the wall at intervals not more than 2 feet, with corrosion-resistant bolts not less than $\frac{1}{4}$ -inch diameter. Bolts shall be set in masonry and secured by lead shields.

- (d) Ties shall be of corrosion-resistant metal manufactured for the purpose of holding glass veneer sheets to masonry surfaces. There shall be not less than one approved tie for each 2 square feet of veneer surface.

- (e) Exterior glass veneer shall be applied only on masonry, concrete or stucco surfaces.

7-8.401.4 Expansion joints. Glass veneer units shall be separated from each other and from adjoining materials by an expansion joint at least $\frac{1}{16}$ inch thick. There shall be at least a $\frac{1}{64}$ -inch clearance between bolts and adjacent glass.

SECTION 7-8.501 PLASTIC VENEER

7-8.501.1 Criteria. Plastic veneer shall be designed in accordance with Section 902, and shall be installed in accordance

with Chapter 7 and Section 1008, and with the following requirements:

- (a) **Height.** The approved veneer shall not be attached to an exterior wall above the first story, or 50 feet above the adjacent grade, whichever is greater.
- (b) **Area.** Sections of plastic veneer shall not be more than 250 square feet in area.
- (c) **Separation.** Sections of plastic veneer shall be separated by not less than 4 feet vertically and 2 feet horizontally.

EPCOT STANDARD 7-18

CRITERIA FOR ACCEPTANCE OF FOAM PLASTICS

SECTION 7-18.101 ADMINISTRATIVE REQUIREMENTS

7-18.101.1 Scope.

- (a) The purpose of this Standard is to set forth the conditions under which a foam plastic can be recognized by the Building Official as complying with Section 717.
- (b) The intent is to also provide acceptable diversified tests to justify structural and nonstructural assemblies without complying thermal barriers as specified in Section 717.

SECTION 7-18.201 APPROVED FOAM PLASTICS

7-18.201.1 Maximum flame spread. The maximum flame spread shall not exceed a rating of 75 when tested in accordance with EPCOT Standard 6-3.

- (a) Subsequent sections in this acceptance criteria may require lower flame spread ratings.
- (b) Except as specifically allowed in Section 717, a foam plastic cannot exceed the maximum thickness and density tested based on test specimens with no backing material.

7-18.201.2 Maximum smoke density. The maximum smoke density shall not exceed a rating of 450 when tested in accordance with EPCOT Standard 6-3. Recognition shall be limited based on Subsection 7-18.201.1(b).

7-18.201.3 Products of combustion. Products of combustion shall be no more toxic than those of untreated wood when burned under similar conditions.

- (a) Laboratory analysis shall be gas chromatography and mass spectrometry.
- (b) Biological tests are mandatory to augment laboratory analysis.
- (c) Comparative samples of foam plastic and untreated wood shall be based on equal volumes of foam plastic at the prescribed maximum density and Douglas Fir or Southern Pine.

7-18.201.4 For purposes of this acceptance criteria. Foam plastic is considered a combustible material.

Exceptions:

- 1. Subsection 717.2(a).
- 2. Special considerations based on justifying data.

7-18.201.5 Recognition of fire-resistive construction. The use of foam plastic shall be based on tests conducted in accordance with EPCOT Standard 6-1. Density and thickness of foam plastics in tests set the maximum conditions of recognition.

7-18.201.6 Recognition of foam plastic. Any test under this acceptance criteria is limited to the specific manufacturer and chemical formulation used. Generic descriptions in test reports must be augmented with manufacturer's name and stock number or other precise foam identification. Any consideration contrary to this requires the specific approval of the Building Official.

7-18.201.7 Conditions of use. These conditions are controlled by four basic considerations of this Code, which must be established.

- (a) Combustible or noncombustible construction, the latter being defined in Chapter 2. EPCOT Standard 6-2 shall be the Standard, or as an alternative, establishing equivalency to products presently recognized as non-combustible.
- (b) Fire-resistive or nonrated construction. Recognition of any vertical or horizontal assembly as fire resistive requires testing in compliance with EPCOT Standard 6-1.
- (c) Bearing or nonbearing wall assemblies as defined in Chapter 2.
- (d) Exterior or interior locations.

SECTION 7-18.301 COMPLIANCE WITHOUT TESTING

7-18.301.1 Horizontal or vertical system.

- (a) A horizontal or vertical system containing foam plastic that can be justified analytically for structural compliance with this Code utilizing allowable stresses and loads specified therein can be recognized without testing under the following conditions:
 - 1. A thermal barrier is used that complies with Section 717.
 - 2. Attachment of the thermal barrier is presently justified by tests or can be installed in compliance with specific sections of this Code based on the material involved. One-half-inch Type X gypsum wallboard installed in compliance with EPCOT Standard 1007-4 would be a specific example.
 - 3. Items 1 and 2 would not be a consideration for masonry or concrete walls with cavities filled with foam plastic.
 - 4. Testing relative to Items 1, 2 and 3 may still be necessary.
- (b) Special applications set forth in Subsections 717.2(d) and 717.2(e) will also be applicable.

SECTION 7-18.401 TESTS UNDER SUBSECTION 717.2

7-18.401.1 Finish rating.

- (a) Finish rating is the shorter time span for 250°F average or 325°F maximum temperature rise above ambient on the unexposed face of a thermal barrier exposed to furnace temperatures set forth in Part 2 (Time-Temperature Curve) of EPCOT Standard 6-1.
 1. The temperature rise shall be measured at the interface of the thermal barrier and foam plastic or framing member.
 2. Test specimens shall have a minimum area of 9 square feet with minimum dimensions of 3 feet.
 3. Small-scale furnaces must be properly calibrated to provide results compatible with full-scale complying with ASTM E119. This requires Building Official approval.
- (b) Thermal barriers must remain in place during the finish rating tests for a 15-minute period.
 1. Bearing walls, roofs, floors and ceilings with thermal barriers must be tested by EPCOT Standard 6-1 for the 15-minute period. This involves testing with superimposed loads as set forth in Part 2 (Loading of Tests of Bearing Walls and Partitions) and Part 25 (Loading of Tests of Floors and Roofs) of the referenced Standard.
 2. Thermal barriers applied continuously with no joints and directly to foam plastics on nonbearing walls, floors or roofs may be justified by small-scale tests described in Subsection 7-18.301. Building Official approval prior to commencing tests is necessary.

SECTION 7-18.501 ACCEPTED DIVERSIFIED TESTS UNDER SUBSECTION 717.2

7-18.501.1 Factory mutual.

- (a) A Factory Mutual, full-scale corner test (750-pound crib) for nonbearing wall panels shall be an acceptable test criteria.
- (b) Room test for nonbearing walls and ceiling shall be as set forth herein.
 1. **Test specimen and set-up.**
 - (aa) Eight-foot ceiling height.
 - (bb) Two-foot wall sections totaling 8 feet in length for each wall forming a corner of a room 8 feet wide and 12 feet long fully enclosed with walls and ceiling, except for a 2-foot, 6-inch by 7-foot, 0-inch doorway. (See Figure No. 1.)

2. Sandwich panels.

- (aa) Sandwich panels for walls with structural foam plastic cores shall be installed in the manner intended for actual use. This includes connections along all joints and perimeter.
- (bb) The remaining walls for the 8-foot by 12-foot room shall be framed as necessary using a listed assembly. The 8-foot room dimension opposite the fire source shall contain a 30-inch-wide by 84-inch doorway centered on the 8-foot dimension.
- (cc) The basic ceiling, where sandwich panels are not involved, shall consist of a listed assembly attached to framing and/or decking. Sandwich panels shall be installed in a manner paralleling field installation and with joint sealed. When testing under Section V-C of the Full-Scale Corner Test, floor and roof panels shall comprise the entire ceiling area.
- (dd) Where the test involved other than structural wall panels, the foam shall be applied to the millboard listed assembly in the wall test area and/or 8-foot by 8-foot ceiling test area and covered with protective material as required.
- (ee) In considering Paragraphs (a), (b) and (c), the intent is to have the test assembly duplicate the manner of field installation.

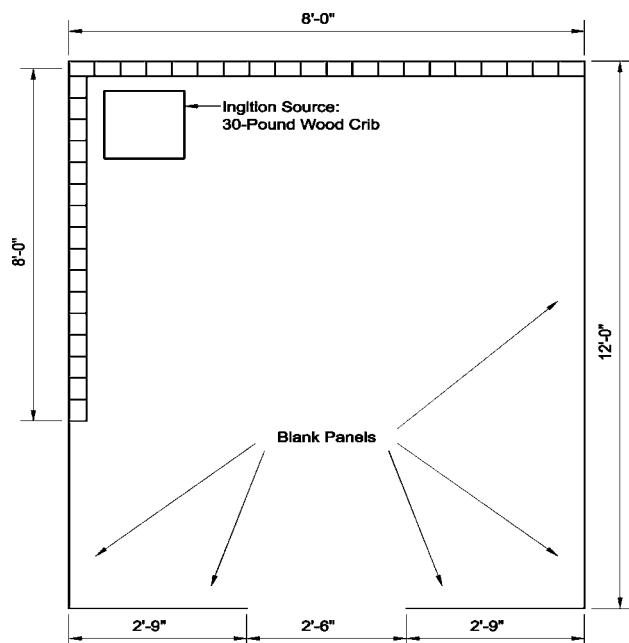


FIGURE NO. 1
(Door 2'-6" Wide by 7'-0" High)
ROOM TEST CONFIGURATION
[See Subsection 7-18.501.1(b)]

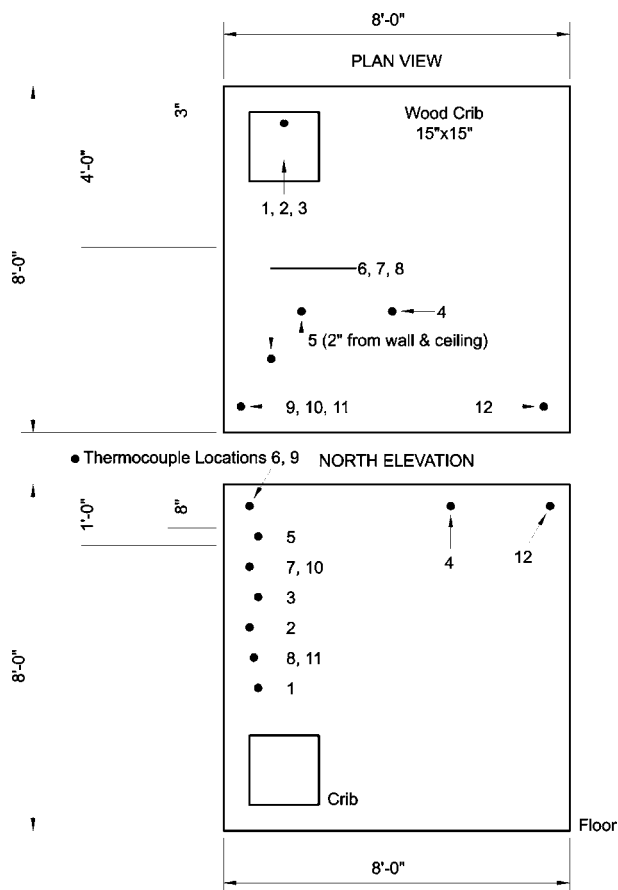


FIGURE NO. 2
ROOM TEST

Notes:

1. All thermocouples spaced 1 inch from adjacent surfaces except as otherwise noted.
2. Thermocouple 4 located 4 feet from the crib corner measured along the diagonal.
3. The room test shall be conducted within a fully enclosed building.
4. See Figure No. 2 for thermocouple locations.
5. A wood crib ignition source shall be constructed of 1½-inch by 1½-inch sticks of White Fir cut to 15-inch lengths. The crib shall have a dry wood weight of 30 pounds and be 15 inches square in plan. One 8-penny nail shall be driven at each intersection of two sticks. After fabrication, the crib shall be conditioned to a maximum constant moisture content of 8 percent.
6. A brick piece, nominally 4 inches by 4 inches, is placed on end at each corner of the crib to provide a 3-inch space between the floor and lower surface of the crib. One pound of shredded, fluffed wood excelsior is distributed around the bricks with the excelsior extending from the wall surfaces and covering an area approximately 21 inches by 21 inches. To start the test, the wood excelsior is soaked with 4 ounces of absolute ethyl alcohol except for an area approximately 6 inches by 6 inches diametrically from the intersection of the walls. The crib is then placed on the bricks 1 inch from the respective wall surfaces. For floors and roofs under Section V-C of the Full-Scale Corner Test, the crib shall be located at the center of the room. At the start of the test clock, a match is placed in the excelsior at the extreme corner diametrically from the wall intersection. See Note 7.
7. Conditions of acceptance. Combustion of the foam plastic shall not extend to the outer extremities of the test area.

(c) As an option, where loading is feasible, the room test may be used to justify bearing walls, floors and roof with the prior permission of the Building Official. The manner of loading must be described in detail and must result in maximum stress conditions. Under this proposal, an additional condition of acceptance is that the system must support its design loads without collapse during the test.

(d) Tests under EPCOT Standard 6-1 for bearing wall, floor and roof assemblies require that after 15 minutes

of testing, the system continue to support the maximum allowable load without collapse.

1. Upon ignition, flames typically progress slowly through the dry excelsior for approximately 10 seconds until the soaked alcohol portion is reached, whereupon flames flash through the entire excelsior, providing uniform application of ignition flame beneath the entire crib.

(e) Ignition temperature tests in compliance with EPCOT Standard 1008-1 are required to augment other diversified tests.

SECTION 7-18.601 MISCELLANEOUS

7-18.601.1 Tests.

- (a) All tests must be conducted by an approved testing agency. Tests may be conducted by the proponent provided a qualified independent consultant specifically approved by the Building Official certifies that preparation of test specimens, testing and reporting of test results comply with the test program approved by the Building Official.
- (b) Test reports must include the following:
 1. Preparation of test specimens.
 2. Description of the room test set-up with details.
 3. Test observations commencing with crib ignition and ending with a final description of panels after all combustion ceases.
 4. Statement on passing or failing Subsections 7-18.501.1(b) and 7-18.501.1(c).
 5. Photographic records of the test.
- (c) All room tests must be approved by the Building Official prior to conducting the tests.
- (d) **Special conditions.**
 1. Foamed plastic roofing as described in Subsection 717.2 must be separated from the interior of the building by a complying thermal barrier or be successfully tested under Subsection 7-18.501.1.
 2. Recognition of specific products or systems may be based on the end use, quantity, location and similar considerations where tests described in Subsection 7-18.501.1 are not applicable or practical.

EPCOT STANDARD 1004-1

REINFORCED GYPSUM CONCRETE

SECTION 1004-1.101 ADMINISTRATIVE REQUIREMENTS

1004-1.101.1 Scope. This Standard specifies methods for the use of reinforced gypsum concrete in buildings hereafter constructed, erected, altered or repaired in accordance with Chapters 9 and 10, and the EPCOT Standards listed in Appendix A for Section 1004.

1004-1.101.2 Testing. Testing shall be performed in accordance with the requirements of Subsection 1004.3 and the specifications listed in Appendix A for Section 1004.

SECTION 1004-1.201 DESIGN AND CONSTRUCTION

1004-1.201.1 Cast-in-place gypsum concrete.

- (a) Cast-in-place reinforced gypsum concrete shall consist of a mixture of gypsum with wood chips, shavings or fiber, or other approved aggregate, premixed by the manufacturer with only water added at the job, and shall conform to the requirements of ASTM C317 (see EPCOT Standard 1004-4). Class A gypsum concrete shall contain a maximum of 12 percent by weight of wood chips, shavings or fiber.
- (b) Cast-in-place reinforced gypsum concrete shall attain the minimum mechanical properties shown in Table 1004-1.1.

**TABLE 1004-1.1
MINIMUM MECHANICAL PROPERTIES
CAST-IN-PLACE REINFORCED GYPSUM CONCRETE**

CLASS	ULTIMATE COMPRESSIVE STRENGTH-f _g (psi)	MODULUS OF ELASTICITY-E (psi)	MODULUS OF RIGIDITY-G (psi)
A	500	200,000	0.36E
B	1,000	600,000	0.40E

- (c) The maximum unit working stresses in reinforced gypsum concrete shall not exceed those set forth in Table 1004-1.2.

**TABLE 1004-1.2
UNIT WORKING STRESSES^a
CAST-IN-PLACE REINFORCED GYPSUM CONCRETE**

TYPE OF STRESS	FACTOR x(fg)	CLASS A (psi)	CLASS B (psi)
Compression—Flexural	0.25	125	250
Compression—Axial	0.25	100	200
Bearing	0.20	100	200
Shear	0.02	10	20
Bond—Deformed bars	0.03	15	30
Plain bars	0.02	10	20
E _g = n	—	150	50

- a. Reinforcing in accordance with Paragraph (h) shall be considered to fulfill the requirements of this Table for bond and shear.

- (d) Bolt and dowel values shall not exceed those set forth in Table 1004-1.3.

**TABLE 1004-1.3
PERMITTED SHEAR ON ANCHOR BOLTS AND DOWELS
REINFORCED GYPSUM CONCRETE**

DEAMETER	MINIMUM EMBEDMENT (inches)	MAXIMUM SHEAR (pounds)
Bolt		
3/8 inch 0	4	325
1/2 inch 0	5	450
5/8 inch 0	5	650
Dowel ^a		
3/8 inch 0	6	325
1/2 inch 0	6	450

- a. Deformed bars conforming to ASTM A615, A616 or A617. (See EPCOT Standards 1003-12, 1003-13 and 1003-14.)

- (e) The maximum diaphragm shears in cast-in-place reinforced gypsum concrete shall not exceed those set forth in Table 1004-1.4 or those calculated for Formula 1 of this Standard. Tabulated diaphragm shear values in Table 1004-1.4 include the one-third increase permitted for wind forces.
- (f) Cast-in-place reinforced gypsum shall be a minimum of 2 inches thick not including formboard, except that when the slab is not being used as diaphragm, the thickness of concrete may be 1 1/2 inches if the overall thickness, including formboards, is not less than 2 inches. In computing diaphragm shears, a maximum thickness of 2 1/2 inches of slab, excluding formboard, shall be used except as specifically approved by the Building Official. When the slab is designed to act as a diaphragm, minimum thickness of concrete over the subpurlins shall be 5/8 inch.
- (g) Subpurlins shall be designed to provide a mechanical lock or key, equivalent to a bulb tee, with the gypsum concrete, and shall be connected to the roof framing by welding or bolting to the supporting members. Bulb tees and subpurlins shall conform to the requirements of ASTM A242 (see EPCOT Standard 1009-20) and ASTM A449 (see EPCOT Standard 1009-23).
- (h) Reinforcing fabric shall be welded steel wire conforming to the requirements of ASTM A185 (see EPCOT Standard 1003-17) or 2-inch hexagonal woven mesh from steel wire conforming to ASTM A82 (see EPCOT Standard 1003-16). The woven wire mesh shall have an additional 16-gage wire perpendicular to the subpurlins at 3 inches on center. Principal reinforcing shall have a minimum cross-sectional area of 0.026 square inches per foot of width and secondary reinforcing shall have a minimum cross-sectional area of 0.0075 square inches

per foot of width. The maximum of spacing of reinforcing bars or wires shall be 8 inches on center. All mesh shall be lapped one mesh or 4 inches, whichever is greater, on edges, and one mesh or 8 inches, whichever is greater on ends.

- (i) Maximum ratio of span to depth for cast-in-place gypsum concrete diaphragm shall be 3:1, where used for lateral support of masonry on concrete walls, and 4:1, where used for lateral support of wood or light steel walls.

1004-1.201.2 Precast gypsum concrete.

- (a) Precast reinforced gypsum concrete shall conform to ASTM C317 and shall contain not more than 3 percent of wood chips, shavings or fiber measured as a percentage by weight of dry mix.
- (b) Precast gypsum concrete units shall be reinforced and, unless marked to ensure their being placed right side up, the reinforcement shall be placed symmetrically relative to the top and bottom.

TABLE 1004-1.4
MAXIMUM DIAPHRAGM SHEAR
REINFORCED GYPSUM CONCRETE^a
(pounds per lineal foot)

CLASS	CONCRETE THICKNESS ^b (inches)	4 in x 8 in MESH No.12 x No.14	6 in x 6 in MESH No.10 x No.10	HEXAGONAL ^c WOVEN MESH
A	2 2 1/2	600 640	700 740	760 800
B	2 2 1/2	920 1,040	1,020 1,140	1,080 1,200

a. Values as computed by Formula 1.

$$\text{Formula 1: } Q = 0.16f_g t C_1 + 100(k_1 d_1 + k_2 d_2)$$

Where:

- Q = Maximum shear on diaphragm, in pounds per lineal foot.
- f_g = Compressive strength of overdry gypsum concrete, in pounds per square inch.
- t = Thickness of gypsum concrete between subpurlins, not including formboard.
- C_1 = 1.0 for Class A or 1.5 for Class B gypsum concrete.
- k_1 = Number of wires per foot passing over and perpendicular to subpurlins.
- d_1 = Diameter of mesh wires passing over and perpendicular to subpurlins.
- k_2 = Number of wires per foot parallel to subpurlins or 0.7 of number of wires composing hexagonal mesh.
- d_2 = Diameter, in inches, of mesh wires parallel to subpurlins or wires composing hexagonal mesh.

b. Not including formboard.

c. Two-inch hexagonal woven wire mesh of 19-gage wire with additional longitudinal 16-gage wires spaced 3 inches on center.

EPCOT STANDARD 1006-2

ENGINEERED BRICK MASONRY

SECTION 1006-2.101 ADMINISTRATIVE REQUIREMENTS

1006-2.101.1 Criteria. This Standard specifies methods for the use of plain and reinforced brick masonry in buildings hereafter constructed, erected, altered or repaired in accordance with the design requirements of Chapters 9 and 10, and the Standards listed in Appendix A for Section 1006.

1006-2.101.2 Definitions. For use in this Code and Standard, the following terms shall have the meanings indicated in this Subsection:

- (a) **Architectural terra cotta.** Plain or ornamental (molded or extruded) hard-burned building units, usually larger than brick, consisting of mixtures of plastic clays, fusible minerals and grog, and having a glazed or unglazed ceramic finish.
- (b) **Ashlar facing.** Facing of a faced or veneered wall composed of solid rectangular units, usually larger than brick, having sawed, dressed or squared beds and mortar joints.
- (c) **Ashlar masonry.** Masonry composed of rectangular units usually larger than brick and securely bonded, having dressed or square heads and mortar joints.
- (d) **Bonder (header).** Masonry unit such as a header that ties two or more wythes (q.v.) of the wall together by overlapping.
- (e) **Brick.** Solid masonry unit shaped approximately as a rectangular prism, usually not more than 4 inches by 4 inches by 12 inches. A brick may be of burned clay or shale, fire clay or mixtures thereof, lime and sand, cement and aggregates or other approved materials.
- (f) **Column.** Upright compression member whose width does not exceed four times its thickness and the height of which exceeds three times its least lateral dimension.
- (g) **Concrete.** Mixture of Portland cement, aggregates and water.
- (h) **Cross-sectional area.** Net cross-sectional area of a masonry unit shall be taken as the gross cross-sectional area minus the area of cores or cellular spaces. Gross cross-sectional area of scored units shall be measured to the outside of the scoring, but the cross-sectional area of the grooves shall not be deducted from the gross cross-sectional area to obtain the net cross-sectional area.
- (i) **Deformed bar.** Reinforcing bar conforming to ASTM A615, A616 and A617 (see EPCOT Standards 1003-12, 1003-13 and 1003-14). Bars not conforming to these specifications are classified as plain bars.
- (j) **Grout.** Mixture of cementitious material and aggregate to which sufficient water is added to produce pouring consistency without segregation of the constituents.
- (k) **Grouted masonry.** Masonry in which the interior cells are filled by pouring grout therein as the work progresses.
- (l) **Header.** See “Bonder.”
- (m) **Hollow masonry unit.** Masonry unit whose net cross-sectional area in any plane parallel to the bearing surface is less than 75 percent of its gross cross-sectional area measured in the same plane. (See “Cross-sectional area.”)
- (n) **Leaf (leaves).** See “Wythe.”
- (o) **Masonry.** Built-up construction or combination of building units of materials, such as clay, shale, concrete, glass, gypsum or stone, set in mortar.
- (p) **Masonry unit.** Brick, tile or block conforming to the requirements of Section 1006-2.201.
 - 1. **Masonry of hollow units.** Masonry consisting of wholly or partly of hollow masonry units laid contiguously in mortar.
 - 2. **Solid masonry.** Masonry consisting wholly of solid masonry units laid contiguously in mortar.
- (q) **Mortar.** Plastic mixture of cementitious materials, fine aggregates and water used to bond masonry or other structural units.
- (r) **Pier.** Isolated column of masonry. A bearing wall not bonded at the sides into associated masonry shall be considered as a pier when its horizontal dimension measured at right angles to the thickness does not exceed four times its thickness.
- (s) **Reinforced grouted masonry.** Solid unit masonry construction in which interior joints of masonry are filled by pouring grout therein and in which reinforcement is embedded.
- (t) **Reinforced hollow masonry.** Hollow unit masonry construction in which certain cells are continuously filled with concrete or grout and in which reinforcement is embedded.
- (u) **Reinforced masonry.** Unit masonry in which reinforcement is embedded as required by this Standard and in such a manner that the two materials act together in resisting forces.
- (v) **Reinforcement.** Structural steel shapes, steel bars, rods, wire fabric or expanded metal embedded or encased in masonry so that the reinforcement works with the masonry in resisting forces.

- (w) **Reinforcement, effective area.** Area obtained by multiplying the right cross-sectional area of the metal reinforcement by the cosine of the angle between its direction and the direction for which the effectiveness of the reinforcement is to be determined.
- (x) **Rubble, coursed rubble.** Masonry composed of roughly shaped stones fitting approximately on level beds, well bonded and brought to continuous level beds or courses at vertical intervals.
1. **Random rubble.** Masonry composed of roughly shaped stones, well bonded and brought to discontinuous but approximately level beds or courses at irregular intervals.
 2. **Rough or ordinary rubble.** Masonry composed of nonshaped or field stones laid without regularity of coursing.
- (y) **Solid masonry unit.** Masonry unit whose net cross-sectional area in every plane parallel to the bearing surface of 75 percent or more of its gross cross-sectional area measured in the same plane. (See "Cross-sectional area.")
- (z) **Stretcher.** Unit laid with length horizontal and parallel to the face of the wall or other masonry member.
- (aa) **Unit masonry.** Built-up construction or combination of masonry units set in mortar or grout.
- (bb) **Veneer.** Nonstructural facing of brick, concrete, stone, tile or other approved material attached to a backing or ornamentation, protection or insulation, but not bonded to exert a common reaction under load.
- (cc) **Wall.** (For definitions of walls other than masonry walls, see Chapter 2):
1. **Cavity wall.** Wall built of masonry units, arranged to provide an airspace within the wall (with or without insulating material), in which the inner and outer wythes of the wall are tied together with metal ties.
 2. **Composite wall.** Walls in which masonry facing and backing are of different materials bonded to exert a common reaction under load.
 3. **Hollow wall.** Wall of masonry arranged to provide an airspace within the wall between the inner and outer wythes of the wall.
 4. **Masonry-bonded hollow wall.** Walls of hollow masonry units in which the inner and outer wythes of the wall are bonded together with masonry units.
 5. **Partly reinforced masonry wall.** Walls designed as plain masonry, except that reinforcement is provided in some parts of the wall to resist flexural tensile stresses.
- (dd) **Wythe (leaf).** Each continuous vertical section of a wall one masonry unit thick and tied to its adjacent vertical section or sections (front and back) by bonders (headers), metal ties or grout.

1006-2.101.3 Testing. Testing and grading of masonry units shall be in accordance with Section 1006, and with the appropriate testing Standard as listed in Appendix A for Section 1006 and as set forth in Table 1006-2.1.

TABLE 1006-2.1
TESTING AND GRADING MASONRY UNITS

UNIT TESTED	TESTING STANDARDS	EPCOT No.	GRADE
Nonloadbearing	ASTM C129	1006-9	Special duty ^b (Not to be used under condition of Note b)
Building brick (clay shale, sand-lime)	ASTM C67	1006-24	MW or SW ^a SW ^b
Structural clay tile and hollow clay or shale masonry Load bearing	ASTM C67	1006-24	LBX (Standard or special duty) ^a
Concrete brick	ASTM C140	1006-25	U-I, U-II, P-I ^a , P-II U-I, U-II ^b
Concrete masonry Load-bearing	ASTM C140	1006-25	U-I, U-II ^a P-I, P-II
Nonloadbearing	ASTM C140	1006-25	Type I
Gypsum tile or block partition tile	ASTM C471M ASTM C473		

a. Subject to action of weather and soil, but not to frost action when permeated with water.

b. Subject to temperature below freezing while exposed to weather or soil.

SECTION 1006-2.201 **MATERIALS**

1006-2.201.1 Standards of quality. Materials used in masonry construction shall comply with the requirements of Section 1006 and with the requirements of the appropriate Standards as listed in Appendix A for the specific material.

1006-2.201.2 Mortar and grout.

- (a) **Mortar.** Mortar, other than gypsum mortar, shall conform to the requirements of ASTM C270 (see EPCOT Standard 1006-23), omitting Type K mortar, and shall be classified in accordance with and comply with the requirements of Table 1006-2.2.
1. Where the classification has not been established by a test for compressive strength, when approved by the Building Official, mortar mixed to the type specified in Table 1006-2.3 is assumed to meet the proper requirements.
 2. The type of mortar used in masonry construction shall comply with the requirements of Table 1006-2.4 for the kind of masonry specified and its use.
 3. Mortar shall be rettempered with water to compensate for any loss from evaporation and to keep its plasticity. Rettempering shall be accomplished by adding water into a basin made with mortar and the mortar reworked with a trowel or other suitable

tool. Harsh nonplastic mortar shall not be retempered or used. Mortar unused after 2 hours from initial mixing shall be removed from the work.

(b) **Grout.** Grout used in masonry construction shall conform to the following requirements:

1. Fine grout shall be Type M, S or N mortar to which water is added to produce a consistency for pouring without segregation of the constituents.
2. Coarse grout shall be the same as fine grout, except that from one to two parts of gravel to one part of cement by volume shall be added in addition to the fine aggregate. In no case shall the sum of the volumes of the fine aggregate and gravel exceed four times the sum of the volumes of the cement and the hydrated lime or lime putty.
3. Type M grout shall be used with Type M mortar. Type M or S grout shall be used with Type S mortar. Type M, S or N grout shall be used with Type N mortar. The minimum compressive strength of the grout shall be 2,000 pounds per square inch (psi).
4. Coarse grout may be used in grout spaces in brick masonry 2 inches or more in horizontal dimension and in grout spaces in filled-cell construction 4 inches or more in both horizontal and vertical directions.

**TABLE 1006-2.2
COMPRESSIVE STRENGTH FOR MORTAR TYPES**

TYPE	AVERAGE COMPRESSIVE STRENGTH AT 28 DAYS (psi)
M	2,500
S	1,800
N	750
O	350

**TABLE 1006-2.3
MORTAR PROPORTIONS**

MORTAR TYPE	PORTLAND CEMENT	MASONRY CEMENT TYPE II (ASTM C91)	HYDRATED LIME OR LIME PUTTY	PROPORTIONS BY VOLUME AGGREGATE (Measured in a damp and loose condition)
M	1	1	—	2 ¹ / ₄ to 3 times
	1	—	1 ¹ / ₄₃ ^a	The sum of the volumes of the cement and lime used
S	1 ¹ / ₂	1	—	
	1	—	1 ¹ / ₄ to 1 ¹ / ₂ ^a	
N	—	1	—	
	1	—	1 ¹ / ₂ to 1 ¹ / ₄ ^a	
O	—	1	—	
	1	—	1 ¹ / ₄ to 2 ¹ / ₄ ^a	

a. 1:10 part maximum when used for grout.

**TABLE 1006-2.4
REQUIREMENTS FOR THE USE OF MORTAR**

KIND OF MASONRY AND USE	TYPE OF MORTAR REQUIRED
Masonry in contact with earth	M or S ^a
Masonry not in contact with earth Piers of solid masonry Piers of hollow units Walls of solid masonry Walls of hollow units	M, S or N M or S M, S or N M, S or N
Cavity walls and masonry-bonded hollow walls where assumed design wind pressure: 1. Exceeds 20 psi 2. Does not exceed 20 psi	M or S M, S or N
Glass block	S or N
Nonbearing partitions or fire protection	M, S, N, O or gypsum
Gypsum partition tile or block	Gypsum
Firebrick	Refractory air-setting
Linings of existing masonry, either above or below grade	M or S

a. Type N mortar may be used where masonry in contact with earth will not be exposed to frost action.

SECTION 1006-2.301 UNREINFORCED MASONRY

1006-2.301.1 Working stresses.

- (a) Stresses shall be calculated on net rather than nominal dimensions, except as permitted in other sections of this Code. Working stresses in unreinforced masonry shall not exceed the values set forth in Table 1006-2.5.
- (b) Working stresses in bearing directly under concentrated loads, on solid masonry or grouted masonry of hollow units, may be 50 percent higher than shown for compression in Table 1006-2.5 when the clear distance between the application of two adjacent concentrated loads is not less than the sum of the widths of bearing.
- (c) When calculating wall stresses, concentrated loads may be distributed over a maximum length of wall, not more than the center-to-center distance between loads. If concentrated loads are not distributed through a structural element, the length of wall considered shall not be more than the width of bearing plus four times the wall thickness. Concentrated loads shall not be considered as distributed by metal ties not distributed across vertical joints.
- (d) In composite walls or other structural members composed of different kinds of grades of masonry units or mortars, the maximum stress for the weakest combination of units and mortars of which the member is composed shall be used.

1006-2.301.2 Lateral support.

- (a) **Ratio of height or length to thickness.** The ratio of unsupported height or length to nominal thickness (one or the other, but not necessarily both) for solid masonry bearing and shear walls of buildings shall not exceed

20 when of solid units, and shall not exceed 18 for walls of hollow masonry units or hollow walls. In computing the ratio for cavity walls, the value for thickness shall be the sum of the nominal thicknesses of the inner and outer wythes. In walls composed of different kinds or classes of units or mortars, the ratio of height or length to thickness shall not exceed the ratio permitted for the weakest combination of units and mortars of which the member is composed.

- (b) **Method of support.** Lateral support may be obtained from cross walls, piers or buttresses when the limiting distance is measured vertically. Sufficient bonding or anchorage shall be provided between the walls and the supports to resist the assumed wind or other horizontal force acting either inward or outward. Piers, buttresses and cross walls relied upon for lateral support shall have sufficient strength and stability to transfer the horizontal force acting in either direction to adjacent structural members or to the ground. When walls are dependent upon floors or roofs for lateral support, provision shall be made to transfer lateral forces to the ground.
- (c) **Piers.** The unsupported height of piers shall not exceed 10 times their least dimension, provided that when structural clay or tile or hollow concrete units are used for isolated piers to support beams or girders, their

unsupported height shall be not more than four times their least dimension, except when the cellular spaces are filled solidly with concrete or grout.

1006-2.301.3 Thickness of masonry walls.

- (a) **Criteria.** The thickness of masonry walls shall conform to the requirements of Subsection 1006-2.301.1 for maximum stresses and to Subsection 1006-2.301.2 for lateral support. Where walls of masonry of hollow units or masonry-bonded hollow walls are decreased in thickness, a course or courses of solid masonry shall be interposed between the wall below and the thinner wall above, or special units or construction shall be used that will transmit the loads from the shells above to those below.
- (b) **Nonbearing and nonshear walls.** The distance between lateral supports of nonbearing partitions of masonry shall be not more than 36 times the thickness of the partition, including the plaster. Gypsum partition tile or block shall not be used in bearing walls, shear walls or where subject to continual dampness. Gypsum partition tile shall not be used for partitions to receive Portland cement plaster, ceramic tile, marble, structural glass wainscoting or other noncompatible materials unless self-furring metal lath is placed over the gypsum tile.

**TABLE 1006-2.5
WORKING STRESSES IN UNREINFORCED UNIT MASONRY**

MATERIAL SPECIAL INSPECTION REQUIRED	TYPE M MORTAR COMPRESSION ^a	Type S MORTAR COMPRESSION ^a	TYPE M OR TYPE S MORTAR				COMPRESSION ^a	TYPE N MORTAR SHEAR OR TENSION IN FLEXURE ^{b, c}	
			Shear or Tension in Flexure ^{b, c}		Tension in Flexure ^d			YES	NO
	NO	NO	YES	NO	YES	NO	NO		
Solid brick masonry (psi)									
4,500 and over	250	225	20	10	40	20	200	15	7.5
2,500 to 4,500	175	160	20	10	40	20	140	15	7.5
1,500 to 2,500	125	115	20	10	40	20	100	15	7.5
Solid concrete and masonry									
Grade A	175	160	12	6	24	12	140	12	6
Grade B	125	115	12	6	24	12	100	12	6
Grouted masonry (psi)									
4,500 and over	350	275	25	12.5	50	25	n.p.	n.p.	n.p.
2,500 to 4,500	275	215	25	12.5	50	25	n.p.	n.p.	n.p.
1,500 to 2,500	225	175	25	12.5	50	25	n.p.	n.p.	n.p.
Hollow unit masonry	85	75	12 ^e	6 ^e	24 ^e	12 ^e	70	10 ^e	5 ^e
Cavity wall masonry									
Solid units ^e									
Grade A or 2,500 psi	140	130	12	6	30	15	110	10	5
Grade B or 1,500 to 2,500	100	90	12	6	30	15	80	10	5
Hollow units ^e	70	60	12	6	30	15	50	10	5
Stone masonry									
Cast stone	400	360	8	4	n.p.	n.p.	320	8	4
Natural stone	140	120	8	4	n.p.	n.p.	100	8	4
Gypsum masonry	20	20	n.p.	n.p.	n.p.	n.p.	20	n.p.	n.p.

n.p.—not permitted.

a. Maximum axial or flexural compressive stresses, in pounds per square inch of gross cross-sectional area (except as noted).

b. Value of tension based on tension across a bed joint, i.e., vertically in standard masonry work.

c. No tension permitted in stack bond across head joints.

d. Values are for tension in masonry in the direction of running bond, i.e., horizontally between supports.

e. Net area in contact with mortar or net cross-sectional area.

1006-2.301.4 Bond.

(a) **Reinforcement.** Bond of masonry units in a single wythe shall be provided by lapping units in alternate vertical courses. Where masonry units are laid in stack bond, steel bar or wire reinforcement, or other approved joint reinforcement shall be embedded in the horizontal mortar beds at vertical intervals of not more than 16 inches. The longitudinal bars or wires of such reinforcement shall be not less than 9 gage and at least one longitudinal bar or wire shall be provided for each 6 inches of wall thickness or fraction thereof. Reinforcement shall be placed in mortar joints. The minimum mortar joint thickness shall be as required for reinforced masonry.

(b) **Walls of solid units.** The facing and backing of solid masonry bearing and nonbearing walls shall be in accordance with the following provisions:

1. The facing and backing shall be bonded so that not less than 4 percent of the wall surface of each face is composed of bonders extending not less than 4 inches into the backing. The distance between adjacent full-length headers shall be not more than 24 inches either vertically or horizontally. In walls in which a single bonder does not extend through the wall, bonders from the opposite sides shall overlap at least 4 inches or bonders from opposite sides shall be covered with another bonder course overlapping the bonder below by at least 4 inches.
2. The facing and backing shall be bonded with corrosion-resistant metal ties conforming to the requirements of Paragraph (f) for cavity walls. Walls so bonded shall conform to the requirements for maximum stresses, lateral support, thickness (excluding cavity), height and mortar requirements for cavity walls. Where space between metal-tied wythes is solidly filled with mortar, the requirements for maximum stresses and other provisions regulating masonry-bonded walls shall apply.

(c) **Walls of hollow units.** Walls of hollow masonry units shall comply with the following requirements:

1. Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals of not more than 34 inches by lapping at least 4 inches over the unit below, or by lapping at vertical intervals of not more than 17 inches with units at least 50 percent thicker than the units below; or by bonding with corrosion-resistant metal ties conforming to the requirements of Paragraph (f).
2. Walls bonded with metal ties shall conform to the requirements for maximum stresses, lateral support, thickness (excluding cavity), height and mortar for cavity walls. Where the space between metal-tied wythes is solidly filled with mortar, requirements for masonry-bonded walls shall apply.

3. Hollow masonry units shall have full mortar coverage of the ends and edges of the face shells in horizontal and vertical joints.

(d) **Stone walls.** Stone walls shall comply with the following requirements:

1. In ashlar masonry, bond stones uniformly distributed shall be provided to the extent of not less than 10 percent of the area of exposed faces.
2. Rubble stone masonry 24 inches or less thick shall have bond stones with a maximum spacing of 3 feet vertically and 3 feet horizontally, and if the masonry is over 24 inches thick, there shall be one bond stone for each 6 square feet of wall surface on both sides.

(e) **Faced walls (composite walls).** Faced walls shall comply with the following requirements:

1. Net thickness of materials used for masonry facing shall be not less than 2 inches and not less than one-eighth the height of the unit. Masonry facing shall be bonded to the backing as required in Paragraph (b).
2. The percentage of bond stones for ashlar masonry shall be computed from the exposed face area of the wall. At least 10 percent of the face area shall consist of bond stones extending 4 inches or more into the backing and the bond stones shall be evenly distributed.
3. Every bonding stone, and except when alternate courses are full bond courses, every stone, shall be securely anchored to the backing with corrosion-resistant metal anchors with a cross section of not less than $\frac{3}{16}$ inch by 1 inch, or its equivalent in cross-sectional area. There shall be at least one anchor to each stone and not less than two for each stone more than 2 feet long and 3 square feet in face area; facing stones of larger size shall have at least one anchor to each 4 square feet of the face area of the unit as applied, but not less than two anchors.

(f) **Hollow walls (cavity and masonry bonded).** Hollow walls of masonry shall comply with the following requirements:

1. Facing and backing of cavity walls shall be bonded with $\frac{3}{16}$ -inch-minimum diameter steel rods or metal ties of equivalent stiffness embedded in horizontal joints.
2. Ties in alternate course shall be staggered, the maximum vertical distance between ties shall be 18 inches and the maximum horizontal distance shall be 36 inches.
3. Rods bent to rectangular shape shall be used with hollow masonry units laid with cells vertical; in other walls, the ends of ties shall be bent to a 90-degree angle to provide hooks not less than 2 inches long. Additional bonding ties shall be provided at openings, spaced not more than 3 feet

around the perimeter and within 12 inches of the opening.

4. Ties shall be of corrosion-resistant metal or coated with a corrosion-resistant metal or other approved protective coating. Masonry-bonded hollow walls shall be bonded as required in Paragraph (b)1.

(g) **Bonding of intersecting walls.** Masonry walls shall be securely anchored or bonded at points where they intersect and where they abut or adjoin the structural frame of a building, except when other provisions are made for lateral support of the walls. Anchored or bonded intersecting walls shall conform to the following requirements:

1. When two walls meet or intersect and the courses are built up together, the intersections shall be bonded by laying in a true bond at least 50 percent of the units intersecting.
2. When the courses of meeting and intersecting walls are carried up separately, the intersecting walls shall be regularly toothed or blocked with 8-inch-maximum offsets and the joints shall be provided with metal anchors having a minimum section of $\frac{1}{4}$ inch by $1\frac{1}{2}$ inches with ends bent up at least 2 inches, or with $\frac{1}{2}$ -inch round by 4-inch cross pins to form anchorage. Such anchors shall be at least 2 feet long, spaced not more than 4 feet.

1006-2.301.5 Grouted masonry.

(a) **Definition.** Grouted masonry is that form of construction made with brick or solid concrete brick units in which interior joints of masonry are filled by pouring grout therein as the work progresses. Grouted hollow unit masonry is made with hollow masonry units in which the cells are continuously filled with concrete or grout. At the time of laying, all masonry units shall be clean and free of deleterious substances. Type M or S mortar containing lime or lime putty shall be used.

(b) **Low-lift grouted construction.** Low-lift grouted masonry construction shall conform to the following requirements:

1. All units in the two outer tiers shall be laid with full shoved head and bed mortar joints. Masonry headers shall not project into the grout space.
2. All longitudinal vertical joints shall be grouted and shall be not less than $\frac{3}{4}$ inch thick. In members three or more tiers thick, interior bricks shall be embedded into the grout so that at least $\frac{3}{4}$ inch of grout surrounds the sides and ends of each unit. All grout shall be puddled with a grout stick immediately after pouring.
3. One exterior tier may be carried up 16 inches before grouting, but the other exterior tier shall be laid up and grouted in lifts not more than six times the width of the grout space, with a maximum of 8 inches.

4. If the work is stopped for 1 hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same level and with the grout 1 inch below the top.

(c) **High-lift grout construction.** High-lift grouted masonry shall conform to the following requirements:

1. All units in the two tiers shall be laid with full head and bed mortar joints.
2. The two tiers shall be bonded together with wall ties. Ties shall be not less than 9-gage wire in the form of rectangles 4 inches wide and 2 inches long less than the overall wall thickness. Kinks, water drips or deformations shall not be permitted in the ties. One tier of the wall shall be built up not more than 16 inches ahead of the other tier. Ties shall be laid not more than 24 inches on center horizontally and 16 inches on center vertically for running bond, and not more than 24 inches on center horizontally and 12 inches on center vertically for stack bond. Every fourth tie vertically shall coincide with the vertical reinforcement of the wall, and shall be used as a centering element.
3. Cleanouts shall be provided for each pour by leaving out every other unit in the bottom tier of the section being poured. During the work, a high-pressure jet stream of water or air shall be used to remove mortar fins and any other foreign matter from the grout space. The cleanout shall be sealed after inspection and before grouting.
4. The grout space (longitudinal vertical joint) shall be not less than 3 inches wide and not less than the thickness required by the placement of steel with the required clearances and shall be poured solidly with grout. If the grout space contains no horizontal steel, it may be reduced to 2 inches. Masonry walls shall cure at least three days to gain strength before pouring grout.
5. Vertical grout barriers or dams shall be built of solid masonry across the grout space the entire height of the wall to control the flow of the grout horizontally. Grout barriers shall be not more than 25 feet apart.
6. Grout shall contain an approved shrinkage compensating admixture, shall be a plastic mix suitable for pumping without segregation of the constituents and shall be mixed thoroughly. Grout shall be placed by pumping or by an approved alternative method and shall be placed before an initial set occurs and not more than $1\frac{1}{2}$ hours after water has been added.
7. Grouting shall be done in a continuous pour, in lifts not more than 4 feet. The grouting shall be consolidated by puddling or mechanical vibrating during placing and reconsolidated after excess moisture has been absorbed, but before plasticity is lost. The grouting of a section of a wall

between control barriers shall be completed in one day with no interruptions longer than 1 hour.

8. Special engineering inspection shall be provided immediately prior to and during grouting. This inspection shall qualify the work for use of higher stresses in accordance with Table 1006-2.5.

(d) **Grouted hollow unit masonry.** Grouting in hollow unit masonry shall be done in accordance with the requirements of Subsection 1006-2.401.4.

1006-2.301.6 Glass block masonry.

- (a) **Limitations.** Masonry of glass blocks may be used in nonload-bearing, nonfire-resistive exterior or interior walls and in openings that otherwise might be windows, and may be isolated or in continuous bands when the glass block panels are not less than 3½ inches thick at the mortar joints and the mortared surfaces of the blocks are treated in an approved manner for mortar bonding. Glass block panels for exterior walls shall have not more than 144 square feet of unsupported wall surface, nor be more than 25 feet long and 20 feet high between supports. For interior walls, glass block panels shall have not more than 250 square feet of unsupported wall surface, nor be more than 25 feet in one direction between supports.
- (b) **Mortar.** Glass block shall be laid in Type N or S mortar. Vertical and horizontal mortar joints shall be not less than ¼ inch thick and not more than ⅜ inch thick and shall be completely filled.
- (c) **Exterior glass block panels.** Installation of exterior glass block panels shall comply with the following requirements:
 1. Panels shall be held in place in the wall opening to resist external and internal wind pressure.
 2. Panels shall be set in recesses at the jambs and for panels more than 10 feet in horizontal dimension between supports, at head and base, as well. Recesses shall have a bearing surface at least 1 inch wide along the panel edge.
 3. When approved by the Building Official, anchorage may be provided by perforated strips of non-corrodible material when:
 - (aa) Panel is not more than 100 square feet in area, nor 10 feet in horizontal or vertical dimension.
 - (bb) Panel is not located above the fourth floor and is less than 52 feet above grade level.
 4. Reinforcement shall be provided in horizontal mortar joints, extending from end to end of the joints, but not across expansion joints. Where joints cannot be avoided, they may be spliced by lapping the reinforcement not less than 6 inches.
 5. Reinforcement shall be spaced not more than 2 feet vertically.
 6. Reinforcement shall be placed in the mortar joint immediately above and below openings in a

panel and shall consist of two parallel longitudinal galvanized steel wires, 9 gage or larger, spaced 2 inches and having welded thereto cross wires, 14 gage or larger, at intervals not more than 8 inches or an equivalent.

7. Exterior glass block panels shall have ½-inch expansion joints at sides and top. Expansion joints shall be free of mortar and shall be filled with resilient material.

SECTION 1006-2.401 REINFORCED MASONRY

1006-2.401.1 Criteria.

- (a) **Construction.** Reinforced masonry construction shall comply with the requirements of Section 1006 and ACI 530.

(b) Mortar and grout.

1. Mortar used in reinforced masonry construction shall comply with Section 1006-2.201 and with the requirements of ACI 530, except that mortar proportions shall comply with the requirements set forth in Table 1006-2.3 for Type M or S mortar mixed with Portland cement.
2. Grout shall be mixed in accordance with the requirements of ACI 530, except that proportions shall comply with the requirements of Subsection 1006-2.801.2(b).

1006-2.401.2 Fine grout shall be used in lieu of MG grout and coarse grout shall be used in lieu of PG grout.

1006-2.401.3 Strength of masonry. Determination of compressive strength of masonry shall be in accordance with EPCOT Standard 1006-1.

1006-2.401.4 Reinforced grouted masonry. Reinforced grouted masonry shall comply with the requirements of EPCOT Standard 1006-1.

1006-2.401.5 Reinforced hollow masonry. Reinforced hollow unit masonry shall comply with the following requirements:

- (a) Type M or S mortar shall be used.
- (b) All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells shall be full-bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses or by equivalent mechanical anchorage.
- (c) Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches.
- (d) All cells containing reinforcement shall be filled solidly with grout.

- (e) All grout shall be consolidated at the time of pouring by puddling or vibrating and then reconsolidated by again puddling before plasticity is lost.
- (f) Low-lift grouted construction shall comply with the following requirements:
 1. In any one day, the height of pour shall not exceed 4 feet.
 2. When grouting is stopped for 1 hour or longer, horizontal construction joints shall be formed by stopping the grout 1 inch below the top of the uppermost unit.
- (g) High-lift grouted construction shall comply with the following requirements:
 1. Grouting shall be done in a continuous pour, in lifts not more than 4 feet.
 2. Grouting shall have no interruptions of more than 1 hour between lifts.
 3. Cleanout openings shall be provided at the bottom of all cells and pours to be filled with grout; openings shall be sealed after inspection and before grouting.
 4. Special engineering inspection prior to and during grouting shall be provided and shall qualify the work for use of higher stresses.

1006-2.401.6 Reinforced masonry columns and walls. Reinforced masonry columns and walls shall conform to the following requirements:

- (a) Design and construction of reinforced masonry columns and walls shall conform to the requirements of this Standard and EPCOT Standard 1006-1.

SECTION 1006-2.501 MISCELLANEOUS MASONRY REQUIREMENTS

1006-2.501.1 Anchoring walls.

- (a) Masonry walls that meet or intersect walls, floors or structural frames shall be securely bonded or anchored thereto where they provide the lateral support of the walls.
- (b) The ends of structural members bearing on masonry walls or piers shall be securely fastened to the walls or piers by an approved method.
- (c) When lateral support for walls is to be provided by anchorage to floor or roof joists that are parallel to the walls, the anchors shall be spaced at intervals not more than 6 feet and shall engage not less than three joists; these joists shall be bridged solidly at the anchors.
- (d) Other methods of anchoring masonry walls may be approved by the Building Official when engineering calculations are submitted in their support.

1006-2.501.2 Chases and recesses. Chases and recesses in masonry walls shall be designed and constructed so as not to reduce the required strength or fire resistance of the wall.

1006-2.501.3 Pipes and conduits embedded in masonry. No pipe or conduit shall be embedded in structural masonry

that is necessary for structural stability or required fire protection, except under the following conditions:

- (a) Rigid electric conduits may be embedded in structural masonry when their location has been detailed on the approved plans.
- (b) Pipes and conduits may pass vertically or horizontally through masonry by means of a sleeve at least large enough to pass any hub or coupling on the pipeline. Such sleeves shall be placed not closer than 3 diameters center-to-center; they shall not impair the strength of construction.
- (c) Placement of pipes or conduits in unfilled cores of low unit masonry shall not be considered as embedment.

1006-2.501.4 Arches and lintels. Members supporting masonry shall be of noncombustible materials. Steel or reinforced masonry lintels shall be of sufficient stiffness to carry the superimposed load without deflection of more than $\frac{1}{360}$ of the clear span.

1006-2.501.5 Corbeling.

- (a) Except for chimneys, the maximum corbeled horizontal projection beyond the face of the wall shall be not more than one-half of the wall thickness and the maximum projection of one unit shall not be more than one-half the depth, nor one-third the width of the unit, measured at right angles to the face of the wall that is offset.
- (b) No chimney shall be corbeled from a wall more than 6 inches, nor shall a chimney be corbeled from a wall that is less than 12 inches thick, unless the chimney projects the same distance on each side of the wall. In the second story of two-story dwellings, corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. Corbeling shall be not more than a 1-inch projection for each course of brick projected.

1006-2.501.6 Cornices. Centers of gravity of stone cornices shall be inside of the outer wall face. Terra cotta cornices and metal cornices shall be supported structurally.

1006-2.501.7 Masonry chimneys.

- (a) Masonry chimneys shall be designed, anchored, supported and reinforced as required in this Standard and in accordance with the requirements of Chapter 9 of the *EPCOT Mechanical Code*. No chimney shall support a structural load other than its own weight, unless the chimney is designed to act as a supporting member. Every masonry chimney shall have walls of masonry units, brick, stone, reinforced concrete or equivalent solid thickness of hollow masonry and shall be lined with liners as required in the *EPCOT Mechanical Code*.
- (b) Wood members used in chimney construction shall meet the requirements of the *EPCOT Mechanical Code* for clearances.

1006-2.501.8 Drainage of hollow walls. In cavity walls, the cavity shall be kept clear of mortar droppings during construction. Approved flashing shall be installed in hollow walls and drainage shall be provided to keep dampness from the backing.

1006-2.501.9 Masonry veneer. Veneer of masonry units shall comply with the requirements of Section 710 and EPCOT Standard 7-8 for application. Design of masonry veneer shall comply with the requirements of Section 902.

1006-501.10 Anchor bolts. Bolts fully embedded in masonry shall have values not to exceed those set forth in Table 1006-2.6.

**TABLE 1006-2.6
MAXIMUM SHEAR ON BOLTS FOR MASONRY**

DIAMETER (inches)	EMBEDMENT (inches)	SOLID MASONRY (shear, pounds)	GROUTED MASONRY (shear, pounds)
$\frac{1}{2}$	4	350	550
$\frac{5}{8}$	4	500	750
$\frac{3}{4}$	5	750	1,100
$\frac{7}{8}$	6	1,000	1,500
1	7	1,250	1,850 ^a
$1\frac{1}{8}$	8	1,500	2,250 ^a

a. Permitted only with not less than 2,500 pound units.

EPCOT STANDARD 1009-5

STEEL

SECTION 1009-5.101 ADMINISTRATIVE REQUIREMENTS

1009-5.101.1 Scope. This Standard specifies methods for the use of structural steel, light gage cold-formed structural steel members, and open-web and long-span steel joists for buildings hereafter constructed, erected, altered or repaired in accordance with the requirements of Chapters 9 and 10, and this Standard. The EPCOT Standards listed in Appendix A for Section 1009 also shall apply.

1009-5.101.2 Testing. Tests shall be conducted in accordance with the requirements of Subsection 1004.3 and with the requirements of the testing specifications listed in Appendix A for Section 1009, as amended by this Standard.

SECTION 1009-5.201 STRUCTURAL STEEL

1009-5.201.1 Quality and design. The quality and design of structural steel shall comply with the requirements of American Institute of Steel Construction (AISC) (see EPCOT Standard 1009-1 or 1009-40) as modified by this Section.

1009-5.201.2 Material. Structural steel material shall conform to AISC (see EPCOT Standard 1009-1 or 1009-40) with the following modifications:

- (a) Structural steel shapes and plates shall be identified and marked as specified in ASTM A36 for the grade ordered. Mill test reports and certificates may be accepted by the Building Official as satisfactory identification.
- (b) The fabricator shall maintain procedures and records of the mill-identified material, so that the mill test reports and certificates can be considered as identification acceptable to the Building Official.
- (c) Steel that is not properly identified as to grade shall be tested by an approved independent agency for conformity to the specified grade.
- (d) The Building Official may waive testing or identification of steel designed for working stresses not more than 50 percent of those permitted for ASTM A36.

1009-5.201.3 Arc and gas cutting. Cutting of structural steel shall comply with the requirements of AISC with the following modifications:

- (a) Structural steel exposed to the weather shall receive at least one additional coat of paint or equivalent protective coating after erection.
- (b) Members having a corrosion-resistant metallic or other equivalent approved coating are not required to be shop and field painted.
- (c) Where structural members are exposed to the fumes from industrial plants, to fresh water, saltwater spray or other corrosive agents, such members shall be pro-

ected with a corrosion-resistant metallic finish or an equivalent approved coating.

- (d) Corrosion-resistant steel, with or without painting or coating, may be approved where sufficient test data or other factual data are submitted to and approved by the Building Official, establishing satisfactory performance under the specific exposure conditions or use.

SECTION 1009-5.301 LIGHT GAGE STEEL

1009-5.301.1 Quality and design. The quality and design of light gage cold-formed steel structural members shall comply with the requirements of the applicable Standards listed in Appendix A for Section 1009, and with the provisions of the American Iron and Steel Institute (AISI) (see EPCOT Standard 1009-2) as modified by this Section.

- (a) Gage, as referred to in this Section, shall be the thickness of the base material, without coating, according to U.S. standard gage; or when galvanized, the material shall be 2½ ounces per square foot heavier or 0.0037 inches thicker than U.S. standard gage, regardless of weight or thickness of galvanizing.
- (b) Structural sheet sections shall have a minimum thickness of 22 gage for floors and 30 gage for roofs and walls. Light gage steel studs shall have the following minimum thicknesses:
 1. **Bearing walls.** Eighteen gage and, except where specifically designed as columns, shall be spaced not more than 24 inches on centers.
 2. **Nonbearing partitions.** Exterior and exposed locations—18 gage; interior locations shall be designed for the load and deflection requirements of Chapter 9.
- (c) Light gage steel joists, rafters, purlins, girts and stringers shall have a minimum thickness of 18 gage.

1009-5.301.2 Material. The material used for light gage cold-formed steel structural members shall comply with the requirements of AISI with the following modifications:

- (a) Steel shall be identified as to grade by mill certificates or tests by an approved independent agency and as approved by the Building Official.
- (b) Light gage steel with a specified yield point higher than 33,000 pounds per square inch (psi) shall be marked with the ASTM designation. Members with a yield point higher than 33,000 psi obtained through additional treatment shall be marked with the resulting yield point.
- (c) Identification shall be on each bundle or lift of fabricated items with paint, decal, tag or other means approved by the Building Official. The fabricators' identification system shall be established on record

with the Building Official prior to fabrication. If the steel is not marked as required, or cannot be identified readily to the satisfaction of the Building Official, he may require tests to determine conformance to the applicable specification. The fabricator shall furnish to the Building Official an affidavit certifying that the material supplied complies with the applicable specification.

- (d) If the design stresses do not exceed 50 percent of the maximum stresses permitted for material with a yield point of 25,000 psi, identification and testing may be waived on approval of the Building Official.

1009-5.301.3 Protection against corrosion. Light gage cold-formed steel structural members and assembled panels, except those fabricated of approved corrosion-resistant steel or other approved coating, shall be protected against corrosion with a suitable shop coat of paint or other approved protection. Where directly exposed to the weather, members shall receive one additional coat of protection after erection.

SECTION 1009-5.401 OPEN-WEB AND LONG-SPAN STEEL JOISTS

1009-5.401.1 Quality and design. The quality, design and manufacture of open-web and long-span steel joists shall comply with the requirements of Section 1009, with the appropriate EPCOT Standards listed in Appendix A, and with SJI-AISC (see EPCOT Standard 1009-3) with the following modifications:

- (a) Anchorage and end-bearing steel joists shall conform to SJI-AISC, except that end bearing shall be designed for the maximum stresses for the material being used, as set forth in the applicable Sections of this Code.
- (b) All open-web and long-span steel joists and accessories shall be given one coat of protective paint before the joists and accessories leave the shop. The shop paint shall comply with the requirements of SSPC15 (see EPCOT Standard 1009-38).

1009-5.401.2 Materials. The materials used in the manufacture of open-web or long-span steel joists shall comply with the requirements of SJI-AISC with the following modifications:

- (a) Each bundle or lift of open-web and long-span steel joists shall be identified as to type, size and manufacturer by an approved method, at the time of fabrication. The identification shall be maintained until the material is installed in the structure.
- (b) When mill test reports or other data required by SJI-AISC cannot be verified by the Building Official, test results obtained by an approved independent agency showing compliance with the specification may be required.

SECTION 1009-5.501 WELDING

1009-5.501.1 Quality and design. The quality and design of welded connections in building construction shall conform to the requirements of AWS (see EPCOT Standard 1009-5) and

to the applicable EPCOT Standards listed in Appendix A for Section 1009.

EPCOT STANDARD 1010-9

WOOD

SECTION 1010-9.101 ADMINISTRATIVE REQUIREMENTS

1010-9.101.1 Criteria.

- (a) The quality and design of solid sawn wood members, structural glued-laminated wood members and plywood or nonveneer structural panel assemblies and their fastenings shall conform to the requirements of this Section, and to the basic standards of the industry listed in EPCOT Standards 1010-1 through 1010-36, as amended by this Standard. Other Standards listed in Appendix A for Section 1010 also are adopted as part of this Code. For heavy timber standard, see Section 1010-9.801.
- (b) Classification and grading of all species of lumber shall conform to the requirements of EPCOT Standard 1010-1 for the individual species.

1010-9.101.2 Limitations of use.

- (a) Wood members shall not be used to support the dead load of masonry or concrete, except that nonstructural masonry or concrete floor surfacing not more than 4 inches thick may be supported by wood members and structures may rest on wood piles constructed in accordance with the requirements of Subsection 908.4 and pressure treated in accordance with the requirements of EPCOT Standard 9-5.
- (b) Wood members shall not be used to resist horizontal forces in buildings more than one story when constructed with masonry or concrete, except that wood floor and roof members may be used in horizontal trusses and diaphragms to resist horizontal forces imposed by wind. Wood members shall not be used to transmit lateral forces by rotation of the truss or diaphragm in masonry or concrete buildings. Lateral earth pressures shall not be resisted by wood members in buildings.
- (c) The Building Official may deny permission for use of wood members where permissible grade characteristics or defects are present in a combination that will affect the strength of the member for the use intended.

1010-9.101.3 Identification.

- (a) Where structures are designed for use of stress-grade lumber or where structural glued-laminated timber or plywood is used structurally, the maximum unit stresses for the species and grade shall be shown on the plans filed with the Building Official.
- (b) Structural glued-laminated timber shall be manufactured and identified as required in ANSI/AITC A190.1. (See EPCOT Standard 1010-18.)
- (c) All stress-grade lumber shall be identified by grade mark or Certificate of Inspection issued by an approved agency as conforming to the requirements of EPCOT Standards 1010-11 through 1010-17 for the species used.

- (d) Plywood and other structural-use panels used structurally, including siding, roof sheathing and wall sheathing, subflooring, diaphragms and build-up members, shall be identified and grade marked by an approved agency indicating compliance with the requirements of EPCOT Standards 1010-19 and 1010-32, respectively.
- (e) All lumber, sawn timber, plywood and poles supporting permanent structures are required to be pressure treated as described in the standards listed in Appendix A and shall bear a product identification mark. Quality control inspection agencies for pressure-treated wood shall be certified as to competency of performance by an approved accrediting organization.

All pressure-treated lumber 6 inches or less in thickness and all pressure-treated plywood shall be marked with an indelible ink stamp at the treating facility. The stamp shall contain, as a minimum, the following information:

1. The treating company and plant location.
2. The American Wood Preservers Association (AWPA) standards to which the product is treated.
3. The quality mark of an approved inspection agency, which maintains continued supervision, testing and inspection over the quality of the product as described in AWPA standards.
4. The preservative used.
5. The year of the treatment.
6. The amount of retention of the chemical per cubic foot of wood.
7. The quality standard of the inspection agency.
8. Dry or kiln dried after treatment (KDAT), if applicable.
9. The purpose for which the wood has been treated (ground contact, above ground or foundation).

Exception: When the pressure-treated material will be used where all four sides are in full view and will not be covered by paint or other opaque finish, a Certificate of Treatment may be accepted in lieu of a permanent ink stamp. The certificate shall contain the same information as the stamp.

Pressure-treated wood more than 6 inches in width and more than 6 inches thick shall be marked with an indelible ink stamp or tagged at the treating facility.

- (f) Lumber and plywood required to be fire retardant shall be identified by the seal of an approved independent inspection agency, certifying compliance with AWPA C20 and C27 (see EPCOT Standard 1010-21).

- (g) Wood-based fiberboard and particleboard shall be identified by the manufacturer as meeting the appropriate EPCOT Standard as listed in Appendix A.

SECTION 1010-9.201 MAXIMUM STRESSES

1010-9.201.1 Limits. Stresses shall not exceed the maximum unit stresses for the respective types, species and grades of lumber as follows (as modified by this Standard):

**TABLE 1010-9.1
UNIT STRESSES BY SPECIES**

TYPE AND SPECIES OF LUMBER	DESIGNATION	EPCOT NO.
Solid sawn lumber	See Appendix A	1010-1
Glued-laminated		
Douglas Fir (Coast Region)	See Appendix A	1010-4
WWPA grades of Douglas Fir and larch	See Appendix A	1010-4
Southern Pine	See Appendix A	1010-4
California Redwood	See Appendix A	1010-4
Softwood	See Appendix A	1010-11 through 1010-17

- (a) **Bending stresses.** The maximum units bending stress, as specified in Appendix A of EPCOT Standard 1010-1, shall apply to members loaded with the wide face of the lamination perpendicular to the load. When the wide face of the lamination is parallel to the direction of the load and the member is composed of not less than three laminations, 115 percent of the bending stress as specified in EPCOT Standard 1010-1 may be used.
- (b) **Grades.** Studs, joists, rafters, foundation plates or sills planking 2 inches or more thick; beams, stringers, posts, structural sheathing and other load-bearing members shall be of at least minimum grades specified in EPCOT Standard 1010-1.
- (c) **Poles or piles.** "The maximum unit stresses for normal loading of round poles or piles used as structural members shall be as specified in EPCOT Standard 9-4 (except that the modulus of elasticity shall be the same for sawn lumber). Poles shall conform to the requirements of EPCOT Standard 1010-22. Piles shall conform to the requirements of EPCOT Standard 9-5.
- (d) The stress values for fire-retardant-treated lumber, including fastener values, shall be determined by an approved method that considers the effects of high heat and high humidity. The testing shall be verified by an approved agency.

Values for light metal plate connectors shall be recommended by each truss plate manufacturer and approved by the Building Official.

Values for glued-laminated timber, including fastener design loads, shall be recommended by the treater and approved by the Building Official.

In addition to the requirements specified in Section 1010-9.901, fire-retardant-treated wood having structural applications shall be tested in accordance with

EPCOT Standard 1010-35 and identified by an approved agency.

1010-9.201.2 Adjustment of maximum stresses. The maximum unit stresses specified in Subsection 1010-9.201.1 and the values for mechanical fastenings, as established in this Standard, shall be subject to adjustment as shown in EPCOT Standard 1010-1.

1010-9.201.3 Compression and tensile members. Columns, posts, struts and other members in compression parallel to grain, consisting of solid wood, structurally glued-laminated lumber or spaced columns shall be designed in accordance with EPCOT Standard 1010-1, and the unit axial tensile stress shall be calculated, using the net area and shall not exceed 67 percent of the maximum bending tensile stress.

1010-9.201.4 Notching and boring. Girders, beams or joists shall not be notched or bored in the middle third of the span. Notches shall not exceed 25 percent of the width of any wood member. Bored holes shall not exceed 40 percent of the width of any wood member and, in no case, shall the edges of the hole be nearer than $\frac{5}{8}$ inch to the edge of the wood member.

1010-9.201.5 Lateral stability of beams. Lateral stability shall be subject to requirements of Section 3.3.3 of EPCOT Standard 1010-1.

SECTION 1010-9.301 CONNECTIONS

1010-9.301.1 Design and installation. Timber connectors, bolts, lagscrews, nails, spikes, drift-bolts and wood screws shall be designed and installed in accordance with EPCOT Standard 1010-1. In nailed joints, the nails shall be spaced center-to-center a distance not less than the required penetration. Edge and end distance shall be not less than one-half the required penetration. Where necessary to prevent splitting, holes for nails shall be pre-drilled.

1010-9.301.2 Mechanical fastenings. Joist hangers, framing anchors, ties and other mechanical fastenings not specifically covered by this Section may be used provided that the values are approved by the Building Official.

1010-9.301.3 Fasteners in preservative-treated and fire-retardant-treated wood. Fasteners for preservative-treated and fire-retardant-treated wood shall be in accordance with ASTM A153.

1010-9.301.3.1 Fasteners for preservative-treated wood. Fasteners for preservative-treated wood shall be of hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. The coating weights for zinc-coated fasteners shall be in accordance with ASTM A153.

Exception: Fasteners other than nails and timber rivets shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B695, Class 55 minimum.

1010-9.301.3.2 Fastenings for wood foundations. Fastenings for wood foundations shall be as required in AF&PA Technical Report No. 7.

1010-9.301.3.3 Fasteners for fire-retardant-treated wood used in exterior applications or wet or damp locations. Fas-

teners for fire-retardant-treated wood used in exterior applications or wet or damp locations shall be of hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Fasteners other than nails, timber rivets, wood screws and lag screws shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B695, Class 55 minimum.

1010-9.301.3.4 Fasteners for fire-retardant-treated wood used in interior applications. Fasteners for fire-retardant-treated wood used in interior locations shall be in accordance with the manufacturer's recommendations. In the absence of manufacturer's recommendations, Section 1010-9.301.3.3 shall apply.

SECTION 1010-9.401 STRUCTURAL GLUED-LAMINATED LUMBER

1010-9.401.1 Design. Design of structural glued-laminated lumber shall comply with Subsection 1010-9.201.1, except as modified by this Section.

1010-9.401.2 Maximum stresses. The maximum unit stresses in structural glued-laminated lumber shall be in accordance with the requirements of the Standards listed in the first paragraph of this Section, and with the following modifications:

- (a) **Taper.** No taper shall be cut on the tension face of simple beams. On other members subject to bending, a slope not to exceed 1:24 may be used on the tension side when measured from the tangent to the laminations of the section considered. Steeper slopes may be used on the tension face, with approval of the Building Official, on arches and at sections increased in size beyond design requirements for architectural projections.
- (b) **Radial stress.** The maximum radial stress in curved sections shall be computed as set forth in Part V of Standard 1010-1.
- (c) **Fabrication.** Structural glued-laminated lumber shall be fabricated as specified in ANSI/AITC A190.1 (see EPCOT Standard 1010-18). End joints in laminations shall conform to ANSI/AITC A190.1, except that all test values must exceed twice the highest maximum bending or tension value for normal conditions or loading used in design.

SECTION 1010-9.501 DIAPHRAGMS AND SHEAR WALLS

1010-9.501.1 General requirements.

- (a) **Deflection.** Wood diaphragms and shear walls may be used to resist lateral forces when the deflection in the plane of the diaphragm, as determined by calculations, tests or analogies drawn therefrom, does not exceed the maximum deflection to which the diaphragm and any supported elements will maintain their structural integrity under assumed load conditions, that is, they would continue to support assumed loads without danger to building or occupants.
- (b) **Horizontal diaphragms.** For buildings having masonry or concrete walls, the use of horizontal dia-

phragms of diagonal sheathing or unblocked plywood, where permitted, shall be limited to one-story buildings or to the roofs of buildings more than one story.

- (c) **Connections.** Ties, connections and anchorages capable of resisting the design forces shall be provided between the diaphragms and the resisting elements. Openings that materially affect the strength of the diaphragm shall be fully detailed on the plans, and shall have their edges adequately reinforced to transfer shearing stresses. Boundary members at edges of diaphragms shall be designed to resist the direct tensile or compressive chord stress.
- (d) **Size and shape.** The size and shape of diaphragms shall be limited as set forth in Table 1010-9.2. In buildings with masonry or concrete walls, straight or diagonal sheathing may not be used for shear walls. In buildings of wood construction where rotation is provided for, transverse shear resisting elements normal to the longitudinal element shall be provided at spacings not more than $1\frac{1}{2}$ times the width for diagonally sheathed diaphragms or two times the width for plywood diaphragms. Construction in which rotation of roof diaphragms is permitted shall be limited in accordance with Subsection 1010.2.

1010-9.501.2 Wood sheathed diaphragms.

- (a) **Sheathing boards.** Diaphragms constructed of 1-inch or 2-inch nominal boards shall have boards laid at right angles to rafters, joists or studs when designed as straight sheathing, or shall have boards laid at an angle of 45 degrees to rafters, joists or studs when designed as diagonal sheathing. Boards shall be 6 inches wide or wider and shall be nailed to each rafter, joist, stud, plate or peripheral blocking as required in Paragraph (b). For 1-inch sheathing, end joints in adjacent boards shall be separated by at least two joints, rafter or stud spaces. For 2-inch sheathing, end joints shall be separated by at least one joist, rafter or stud space.
- (b) **Nailing.** Sheathing boards shall be nailed to each intermediate-bearing member with not less than two 8d nails for each 1-inch by 6-inch board. At the diaphragm boundaries, three 8d and four 16d nails shall be provided at 1-inch and 2-inch boards. Equivalent nailing shall be used for boards wider than 6 inches.
- (c) **Sheathed diaphragms.** Straight sheathed diaphragms may be used to resist shears, caused by wind, or 50 pounds per lineal foot for 1-inch boards and 40 pounds per lineal foot for 2-inch boards. Diagonal sheathed diaphragms may be used to resist shears caused by wind of 300 pounds per lineal foot for 1-inch boards and 400 pounds per lineal foot for 2-inch boards. When double 1-inch diagonal sheathing laid 90 degrees to one another is used, the sheathing may resist wind shear up to 500 pounds per lineal foot.
- (d) **Supports.** Rafters or joists supporting sheathed diaphragms shall not exceed 24 inches on center for 1-inch sheathing and 5 feet for 2-inch sheathing. Walls or partitions carrying lateral loads shall be framed of studs not less than 2 inches by 4 inches spaced 16 inches on center.

TABLE 1010-9.2
MAXIMUM DIMENSION RATIO FOR
HORIZONTAL AND VERTICAL DIAPHRAGMS

MATERIALS	RATIO OF HORIZONTAL MAXIMUM LENGTH TO WIDTH	RATIO OF VERTICAL MAXIMUM HEIGHT TO WIDTH
Metal lath and cement or gypsum plaster	Not permitted	2:1
Fiberboard sheathing	Not permitted	1½:1
1-inch diagonal sheathing	3:1	2:1
1-inch straight sheathing	2:1	2:1
Double 1-inch diagonal sheathing	4:1	3½:1
2-inch diagonal sheathing	3:1	2:1
2-inch straight sheathing	2:1	2:1
Plywood sheathing—unblocked	4:1	Not permitted
Plywood sheathing—blocked	4:1	3½:1

1010-9.501.3 Plywood and particleboard diaphragms.

- (a) **Stresses.** Horizontal and vertical diaphragms sheathed with plywood or particleboard may be used to resist horizontal forces not exceeding those set forth in Table 1010-9.3A for plywood and Table 1010-9.3B for particleboard horizontal diaphragms, and Table 1010.9.4A for plywood and Table 1010-9.4B for particleboard shear walls. Plywood diaphragms may be calculated by principles of mechanics by using values of nail strength and plywood shear values as specified in APA-Engineered Wood Association *Design and Construction Guide—Diaphragm*.

The maximum span permitted for plywood used in horizontal diaphragms shall be as set forth in Table 1010-9.5 and, when used as a combination subfloor underlayment, shall be as set forth in Table 1010-9.6.

(b) **Material.**

1. Plywood used for horizontal or vertical diaphragms shall conform to the requirements of PSI 1 (see EPCOT Standard 1010-19).
2. Particleboard used for horizontal or vertical diaphragms shall conform to the requirements of ANSI/A208.1 (see EPCOT Standard 1010-28).

- (c) **Framing members.** Framing members shall be at least 2-inch nominal dimension to which plywood is attached and such members shall be limited to a maximum of 16 inches on center for vertical diaphragms. Panel edges shall bear on the framing members and butt along their center lines. Nails shall be placed not less than ¾ inch from the panel edge, nor more than 12 inches apart along intermediate supports and 6 inches along panel edge bearings, and shall be firmly driven into the framing members. No unblocked panels less than 12 inches wide shall be used.

1010-9.501.4 Other shear walls.

- (a) **Stresses.** Other wood stud shear walls designed in accordance with the requirements of this Subsection may be used to resist horizontal forces in wood frame

buildings when the values shown in Table 1010-9.7 are not exceeded.

- (b) **Increase in stresses.** The increase in maximum stress for duration of load is included in the values shown in Table 1010-9.7.
- (c) **Lateral loads.** Walls and partitions resisting lateral loads shall be frames of studs not less than 2 inches by 4 inches nominal and shall be spaced not more than 16 inches on center.
- (d) **Plastered walls and partitions.** Plastered walls and partitions designed to resist horizontal loads shall conform to the requirements of Section 1007.
- (e) **Fiberboard sheathing.** Wood stud walls sheathed with fiberboard sheathing complying with ASTM D2277 (see EPCOT Standard 1010-24) may be used to resist lateral loads not exceeding those shown in Table 1010-9.7. Sheathing shall be applied with 8-foot-minimum vertical dimension and nailed with 11-gage galvanized roofing nails with 7/17-inch diameter heads and 1-inch nominal penetration into studs. If the wall exceeds the vertical dimension of the sheathing panel, the horizontal joint shall be blocked with 2-inch nominal blocking. Nails shall be spaced 3 inches on center at all panel edges and 6 inches on center at intermediate supports, and shall be ¾ inch minimum from the edge of the panels.
- (f) **Braces.** When used in combination with any of the shear walls set forth in Table 1010-9.7 and straight sheathing, a 1-inch by 4-inch brace let into the studs may be used to resist an additional horizontal force not exceeding 1,000 pounds when the total value of the shear wall or partition does not exceed 600 pounds per foot. Each brace shall be nailed to each stud and to the top and bottom plates with two 8d nails.
- (g) **Gypsum.** Gypsum lath and plaster, gypsum sheathing board and gypsum wallboard when applied on wood studs in accordance with this Section, may be used as shear walls to resist horizontal forces not to exceed those set forth in Table 1010-9.7. End joints of adjacent panels of gypsum lath, gypsum sheathing board or gypsum wallboard sheets shall not occur over the same stud. Gypsum lath and 2-foot-wide panels of gypsum sheathing shall be applied with the long dimension perpendicular or parallel to the studs.
- (h) **Composite walls.** The shear values set forth in Table 1010-9.7 for a wall made up of a combination of materials shall be considered as the sum of the values of the individual materials, except as follows:
1. The sum of the values shall not exceed 600 pounds per foot.
 2. The values for gypsum lath, sheathing board and wallboard shall not be cumulative with the values for any other material applied to the same wall. The values may be doubled when identical materials are applied to both sides of the wall in accordance with the requirements of this Subsection.
 3. The values set forth in Table 1010-9.4 for plywood shear walls shall not be cumulative with the values for any other material.

TABLE 1010-9.3A
MAXIMUM SHEAR FOR WIND FORCES FOR HORIZONTAL PLYWOOD DIAPHRAGMS^a
(pounds per foot)

PANEL GRADE	COMMON NAIL SIZE	MINIMUM NAIL PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PLYWOOD THICKNESS (inches)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER (inches)	BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
					Nail Spacing at Diaphragms and Continuous Panel Edges Parallel to Load ^b				Nails Spaced 6 inches Maximum at Supported Edges ^b	
					6	4	2½ ^c	2	Load Perpendicular to Unblocked Edges and Continuous Panel Joints	All Other Plywood Configurations
					Nail Spacing at Plywood Panel Edges					
					6	6	4	3		
Structural I	6d	1¼	⅝ ₁₆	2	188	250	375	420	167	125
				3	210	280	420	475	187	140
	8d	1½	⅜ ₈	2	270	360	530 ^c	600 ^c	240	180
				3	300	400	600	675	267	200
	10d	1⅝ ₈	½ ₂	2	318	425	640 ^c	730 ^c	283	212
				3	360	480	720	820	320	240
C-D, C-C and other grades covered in RCID Standard 1010-8 										

a. Values are for short-time wind loads and shall be reduced 25 percent of normal loading.

b. Nails shall be spread 12 inches on center along intermediate framing members.

c. Where nail spacing is less than 3 inches for 8d and 10d nails, the supporting member shall be at least 2 1/2 inches (net) thick and the edge distance for the supporting member shall be 3/4 inch for nailing.

TABLE 1010-9.3B
ALLOWABLE SHEAR, IN POUNDS PER FOOT, FOR HORIZONTAL OR VERTICAL DIAPHRAGMS
WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE^{a, d}

PANEL GRADE	COMMON NAIL SIZE	MINIMUM NAIL PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inches)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER (inches)	BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
					Nail Spacing at Diaphragms and Continuous Panel Edges Parallel to Load (Cases 3 & 4) and at all Panel Edges (Cases 5 & 6)				Nails Spaced 6 inches Maximum at Supported Edges ^b	
					6	4	2 ¹ / ₄ ^c	2 ^e	Case 1 (no unblocked edges or continuous joints parallel to load)	All Other Configurations (Cases 2, 3, 4, 5 & 6)
					Nail Spacing (inches) at other Panel Edges (Cases 1, 2, 3 & 4)					
					6	6	4	3		
Type 2-M-W	6	5/16	2	170	225	335	380	150	110	
			3	190	250	380	430	170	125	
		1 ¹ / ₄	3/8	2	185	150	375	420	165	125
				3	210	280	420	475	185	140
	8	1 ¹ / ₂	3/8	2	240	320	480	545	215	160
				3	270	360	540	610	240	180
		7/16	3/8	2	255	340	505	575	255	170
				3	285	380	570	645	290	190
2-M-3	10 ^e	1/2	2	290	385	575	655	285	190	
			3	325	430	650	735	320	215	
		1 ⁵ / ₈	5/8	2	320	425	640	730	285	215
				3	360	480	720	820	240	240
	10 ^e	1 ⁵ / ₈	3/4	2	320	425	640	730	285	215
				3	360	480	720	820	320	240

- a. Allowable shear values for nails in framing members of other species set forth in the AF&PA *National Design Specification* shall be calculated for all grades by multiplying the values by the following factors: Group III, 0.82 and Group IV, 0.65.
- b. Space nails 12 inches on center along intermediate framing members.
- c. Framing at panel edges shall be 3 inches nominal or wider and nails shall be staggered where nails are spaced 2 inches or 2 1/2 inches on center.
- d. These values are for short-term loads due to wind or earthquake and must be reduced 25 percent for normal loading.
- e. Framing at adjoining panel edges shall be 3 inches nominal or wider and nails shall be staggered where 10d nails having penetration into framing of more than 1 5/8 inches are spaced 3 or less on center.

TABLE 1010-9.4A
MAXIMUM SHEAR FOR WIND FORCES FOR PLYWOOD SHEAR WALLS^a
(pounds per foot)

PANEL GRADE	MINIMUM NOMINAL PLYWOOD THICKNESS (inches)	MINIMUM NAIL PENETRATION IN FRAMING (inches)	NAIL SIZE ^d	PANELS APPLIED DIRECT TO FRAMING				NAIL SIZE ^d	PANELS APPLIED OVER 1/2 inch GYPSUM BOARD			
				Nail Spacing at Plywood Edges					Nail Spacing at Plywood Edges (inches) ^b			
				6	4	2 1/2	2		6	4	2 1/2	2
Structural I	5/16	1 1/4	6	200	300	450	510	8	200	300	450	510
	3/8	1 1/2	8	230 ^d	360 ^d	530 ^d	610 ^d	10	280	430	640 ^e	730 ^e
	1/2	1 5/8	10	340	510	770 ^e	870 ^e					
Structural II C-D, C-C and other grades covered in PS- 1-83 RCID Standard 1010-8	5/16	1 1/4	6	180	270	400	450	8	180	270	400	450
	3/8	1 1/2	8	220 ^d	320 ^d	470 ^d	530 ^d	10	160	380	570 ^e	640 ^e
	1/2	1 5/8	10	310	460	690 ^e	770 ^e					
Panel plywood siding in grades covered in PS-1-83 RCID Standard 1010-8	5/16 ^c	1 1/4	6 ^b	140	210	320	360	8 ^b	140	210	320	360
	3/8	1 1/2	8 ^b	130 ^d	200 ^d	300 ^d	340 ^d	10 ^b	160	240	360	410

- a. Panel edges shall be backed with 2-inch nominal or wider framing. Plywood may be installed either horizontally or vertically. Nails shall be spaced 12 inches on center along intermediate framing members. Values are for short-time wind loads and shall be reduced 25 percent for normal loading.
- b. Galvanized casing nails.
- c. 3/8-inch or 303-160.C, is minimum recommended when applied direct to framing as exterior siding.
- d. Shears may be increased 20 percent provided (1) studs are spaced a minimum of 16 inches on center, (2) plywood is applied with face grain across studs or (3) plywood is 1/2 inch or greater in thickness.
- e. Reduce tabulated shears 10 percent when boundary members provide less than 3-inch nominal nailing surface.

TABLE 1010-9.4B
ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES IN POUNDS PER FOOT FOR
PARTICLEBOARD SHEAR WALLS WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE^{a, f}

PANEL GRADE	MINIMUM NOMINAL PANEL THICKNESS (inches)	MINIMUM NAIL PENETRATION IN FRAMING (inches)	PANELS APPLIED DIRECT TO FRAMING						PANELS APPLIED OVER 1/2 INCH GYPSUM BOARD			
			NAIL SIZE (Common or Galvanized box)	Nail Spacing at Panel Edges (inches) ^b				NAIL SIZE (Common or Galvanized box)	Nail Spacing at Plywood Edges (inches) ^b			
				6	4	3	2		6	4	3	2 ^e
TYPE 2-M-W	5/16	1 1/4	6d	180	270	350	450	8d	180	270	350	450
	3/8			200	300	390	510		200	300	390	510
	3/8	1 1/2	8	220 ^c	320 ^c	410 ^c	530 ^c	10d	260	380	490 ^c	640
	7/16			240 ^c	350 ^c	450 ^c	585 ^c					
	1/2	1 5/8	10d ^d	260	380	490	640					
	1/2			310	460	600	770					
	5/8			340	510	655	870					

- a. For framing of other species, find species group of lumber in AF&PA *National Design Specification*. Find shear value from this Table for nail size. Multiply this value by 0.82 for Lumber Group III or 0.65 for Lumber Group IV.
- b. All panel edges backed with 2-inch nominal or wider framing. Install panels either horizontally or vertically. Space nails 6 inches on center along intermediate framing members for 3/8 inch and 7/16 inch in panels installed on studs spaced 24 inches on center. For other conditions and panel thickness, space nails 12 inches on center on intermediate supports.
- c. The allowable shear values may be increased to the values shown for 1/2-inch-thick sheathing with the same nailing, provided the studs are spaced a maximum of 16 inches on center.
- d. Framing at adjoining panel edges shall be 3-inch nominal or wider and nails shall be staggered where 10d nails having penetration into framing of more than 1 5/8 inches are spaced 3 inches or less on center.
- e. Framing at panel edges shall be 3-inch nominal or wider. Nails shall be staggered where nails are spaced 2 inches on center.
- f. These values are for short-term loads due to wind or earthquake and must be reduced 25 percent for normal loading.

TABLE 1010-9.5
MAXIMUM SPANS FOR PLYWOOD FLOOR AND ROOF SHEATHING
(Plywood Continuous over Two or More Spans and Face Grain Perpendicular to Supports)^a

PANEL IDENTIFICATION INDEX ^d	MAXIMUM SPAN (inches)		ROOF ^b LOAD (psf)		FLOOR MAXIMUM SPAN ^c (inches)
	Edges Blocked ^e	Edges Unblocked	Total	Live	
12/0, 5/16	12	—	155	150	0
16/0, 5/16, 3/8	16	—	95	75	0
20/0, 5/16, 3/8	20	—	75	65	0
24/0, 3/8	24	20	65	50	0
30/12, 5/8	30	26	70	50	12 ^f
32/16, 1/2, 5/8	32 ^g	28	55	40	16 ^h
36/16, 3/4	36	30	55	50	16 ^h
42/20, 5/8, 3/4, 7/8	42	32	40 ⁱ	35 ⁱ	20 ^j
48/24, 3/4, 7/8	48	36	40 ⁱ	35 ⁱ	24

- a. Values apply for C-C, C-D Structural I and II grades only. Spans limited to values shown because of possible effect on concentrated loads.
- b. Uniform load deflection limitations: 1/180 of span under live load plus dead load: 1/240 under live load only.
- c. Edges shall have tongue-and-groove joints to be supported with blocking unless 1/4-inch minimum thickness underlayment installed or finish floor is 25/32-inch wood strip. Uniform load is 165 pounds per square foot (psf), based on deflection of 1/360 of span.
- d. Identification index appears on panels in grades listed in Note a.
- e. Edges may be blocked with timber or other approved edge support.
- f. May be 16 inches if 25/32-inch wood strip flooring is installed at right angles to joists.
- g. 1/2-inch Structural I, if continuous over two or more spans, may be laid with face grain parallel to supports when panel edges block or other approved support provided, when spacing of supports is not more than 24 inches on center and live load is not more than 20 psf. For other grades, a thickness of 5/8 inch is required.
- h. May be 24 inches if 25/32-inch wood strip flooring is installed at right angles to joists.
- i. For roof live load of 40 psf, or total load of 55 psf, decrease spans 13 percent or use panel with next higher identification index.
- j. May be 24 inches where a minimum of 1 1/2 inches of approved cellular or lightweight concrete is placed over the subfloor and the plywood sheathing is manufactured with exterior glue.

TABLE 1010-9.5A
ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANEL SHEATHING AND
SINGLE-FLOOR GRADES CONTINUOUS OVER TWO OR MORE SPANS WITH STRENGTH AXIS PERPENDICULAR TO SUPPORTS^{a, b}

SHEATHING GRADES		ROOF ^c				FLOOR ^d
Panel span rating roof/floor span	Panel thickness (inches)	Maximum span (inches)		Load ^e (psf)		Maximum span (inches)
		With edge support ^f	Without edge support	Total load	Live load	
12/0	$\frac{5}{16}$	12	12	40	30	0
16/0	$\frac{5}{16}, \frac{3}{8}$	16	16	40	30	0
20/0	$\frac{5}{16}, \frac{3}{8}$	20	20	40	30	0
24/0	$\frac{3}{8}, \frac{7}{16}, \frac{1}{2}$	24	20 ^g	40	30	0
24/16	$\frac{7}{16}, \frac{1}{2}$	24	24	50	40	16
32/16	$\frac{15}{32}, \frac{1}{2}, \frac{5}{8}$	32	28	40	30	16 ^h
40/20	$\frac{19}{32}, \frac{5}{8}, \frac{3}{4}, \frac{7}{8}$	40	32	40	30	20 ^{h, i}
48/24	$\frac{23}{32}, \frac{3}{4}, \frac{7}{8}$	48	36	45	35	24
54/32	$\frac{7}{8}, 1$	54	40	45	35	32
60/32	$\frac{7}{8}, 1\frac{1}{8}$	60	48	45	35	32
SINGLE-FLOOR GRADES		ROOF ^c				FLOOR ^d
Panel span rating	Panel thickness (inches)	Maximum span (inches)		Load ^e (psf)		Maximum span (inches)
		With edge support ^f	Without edge support	Total load	Live load	
16 o.c.	$\frac{1}{2}, \frac{19}{32}, \frac{5}{8}$	24	24	50	40	16 ^h
20 o.c.	$\frac{19}{32}, \frac{5}{8}, \frac{3}{4}$	32	32	40	30	20 ^{h, i}
24 o.c.	$\frac{23}{32}, \frac{3}{4}$	48	36	35	25	24
32 o.c.	$\frac{7}{8}, 1$	48	40	50	40	32
48 o.c.	$1\frac{3}{32}, 1\frac{1}{8}$	60	48	50	40	48

a. Applies to panels 24 inches or wider.

b. Floor and roof sheathing conforming to this Table shall be deemed to meet the design criteria of this Code.

c. Uniform load deflection limitations $\frac{1}{180}$ of span under live load plus dead load, $\frac{1}{240}$ under live load only.

d. Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking unless $\frac{1}{4}$ -inch minimum thickness underlayment or $1\frac{1}{2}$ inches of approved cellular or lightweight concrete is placed over the subfloor, or finish is $\frac{3}{4}$ -inch wood strip. Allowable uniform load based on deflection of $\frac{1}{360}$ of span is 100 psf, except the span rating of 48 inches on center is based on a total load of 65 psf.

e. Allowable load at maximum span.

f. Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center), lumber blocking or other. Only lumber blocking shall satisfy blocked diaphragm requirements.

g. For $\frac{1}{2}$ -inch panel, maximum span shall be 24 inches.

h. Span is permitted to be 24 inches on center where $\frac{3}{4}$ -inch wood strip flooring is installed at right angles to joist.

i. Span is permitted to be 24 inches on center for floors where $1\frac{1}{2}$ inches of cellular or lightweight concrete is applied over the panels.

TABLE 1010-9.5B
ALLOWABLE SPAN FOR WOOD STRUCTURAL PANEL COMBINATION SUBFLOOR-UNDERLAYMENT (SINGLE FLOOR)^{a, b}
(Panels Continuous Over Two or More Spans and Strength Axis Perpendicular to Supports)

IDENTIFICATION	MAXIMUM SPACING OF JOISTS (inches)				
	16	20	24	32	48
Species group ^c	Thickness (inches)				
1	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	—	—
2, 3	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	—	—
4	$\frac{3}{4}$	$\frac{7}{8}$	1	—	—
Single floor span rating ^d	16 o.c.	20 o.c.	24 o.c.	32 o.c.	48 o.c.

- a. Spans limited to value shown because of possible effects of concentrated loads. Allowable uniform loads based on deflection of $\frac{1}{360}$ of span is 100 psf, except allowable total uniform load for $1\frac{1}{8}$ -inch wood structural panels over joists spaced 48 inches on center is 65 psf. Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless $\frac{1}{4}$ -inch minimum thickness underlayment or $1\frac{1}{2}$ inches of approved cellular or lightweight concrete is placed over the subfloor, or finish floor is $\frac{3}{4}$ -inch wood strip.
- b. Floor panels conforming to this Table shall be deemed to meet the design criteria of this Code.
- c. Applicable to all grades of sanded exterior-type plywood. See EPCOT Standard 1010-19 for PS1 plywood species groups.
- d. Applicable to underlayment grade, C-C (plugged) plywood, and single-floor grade wood structural panels.

TABLE 1010-9.6
MAXIMUM SPANS FOR PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT^a
(Plywood Continuous Over Two or More Spans and Face Grain Perpendicular to Supports)

SPECIES GROUPS ^b	MAXIMUM SPACING FOR JOISTS FOR VARIOUS THICKNESS OF PLYWOOD SUBFLOOR (inches)		
	Joist Spacing		
	16	20	24
	Plywood Thickness		
1	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$
2, 3	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
4	$\frac{3}{4}$	$\frac{7}{8}$	1

- a. Applicable to underlayment grade, C-C (plugged) and all grades of sanded exterior-type plywood. Spans limited to values shown because of possible effect on concentrated loads. Maximum uniform load based on deflection of $\frac{1}{360}$ of span is 100 psf. Plywood edges shall have approved tongue-and-groove joints, or shall be supported with blocking, unless $\frac{1}{4}$ -inch minimum thickness underlayment is installed, or finish floor is $\frac{25}{32}$ -inch wood strips. If wood strips are perpendicular to supports, thicknesses shown for 16-inch and 20-inch spans may be used for 24-inch spans.
- b. See EPCOT Standard 1010-19 for plywood species used.

TABLE 1010-9.7
MAXIMUM SHEAR FOR WOOD FRAMED SHEAR WALLS
 (For Plywood Shear Wall Values, see Table 1010-9.4)

THICKNESS OF SHEATHING MATERIAL (one side only) ^a	MAXIMUM SHEAR (plf)	NAILING REQUIREMENTS EACH BEARING ^b
Metal lath and Portland cement plaster	200	See Section 1007
Fiberboard 7/16 inch 25/32 inch	125 175	See Paragraph c of this Subsection See Paragraph c of this Subsection
Gypsum lath and plaster 3/8-inch gypsum lath and 1/3-inch plaster (no blocking)	100	1 1/8 inch by 13 gage 19/64 inch head plaster board blued nails at 5 inches on center ^c
Gypsum sheathing board 1/2 inch × 2 feet × 8 feet panels (no blocking) 1/2 inch × 4 feet × 8 feet panels; blocked ^d	75 175	1 3/4 inches × 11 gage, 7/16 inch head, diamond point, galvanized at 4 inches on center ^c
Gypsum wallboard 1/2 inch unblocked 1/2 inch unblocked 1/2 inch blocked ^d 1/2 inch blocked ^d 5/8 inch blocked ^d Two layers, 5/8 inch blocked	100 125 125 150 200 300	5d cover nails 7 inches on center 5d cover nails 4 inches on center 5d cover nails 7 inches on center 5d cover nails 4 inches on center 6d cover nails 4 inches on center Base: 6d cover nails 9 inches on center Face: 8d cover nails 7 inches on center ^c

plf = pounds per lineal foot

a. Values may be doubled when identical sheathing materials are applied to both sides of wall.

b. Applies to each stud, top and bottom plates, and blocking where required.

c. Nails shall be placed not less than 3/8 inch from edges of panels.

d. Block all horizontal joints with 2 inches × full width of studs.

SECTION 1010-9.601 WOOD FRAME CONSTRUCTION

1010-9.601.1 Alternative methods. Buildings or parts of buildings or structures constructed of wood shall conform to the requirements of this Section, unless other methods are proved to be satisfactory by engineering calculations or tests acceptable to the Building Official.

1010-9.601.2 Fastenings. The number and size of nails connecting wood members shall be not less than those set forth in Table 1010-9.8.

1010-9.601.3 Protection against decay and termites. Where protection of wood members is required by this Subsection, protection shall be provided by using naturally durable or pressure-treated wood. Wood subject to damage from both decay and termites shall be a naturally durable species resistant to termites or pressure treated.

- (a) **Durable wood.** The expression “durable wood” refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood may be included if 90 percent or more of the width of each side on which it occurs is heartwood.

Decay resistant: Redwood, Cedars and Black Locust.

Termite resistant: Redwood and Eastern Red Cedar.

- (b) **Pressure-treated or preservative-treated wood.** The expression “pressure-treated or preservative-treated wood” refers to wood meeting the retention, penetration and other requirements applicable to the species, products, treatment and conditions of use in the approved standards of the AWPA and the AWPB-FDN, *Quality Control Program for Softwood Lumber, Timber and Plywood Pressure Treated with Water Borne Preservatives for Ground Contact Use in Residential and Light Commercial Foundations* of the American Wood Preservers Bureau.
- (c) **Standards.** The standards of the National Pest Control Association shall be deemed as approved in respect to pre-construction soil treatment for protection against termites.
- (d) **Termite hazard.** In territories where hazard of termite damage is known to be very heavy, the Building Official may require floor framing of termite-resistant wood, pressure-treated wood, soil treatment or other approved methods of termite protection.
- (e) **Exposed structural supports.** In geographical areas where experience has demonstrated a specific need, approved wood of natural resistance or pressure-treated wood shall be used for those portions of wood

members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances when such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members may include horizontal members, such as girders, joists and decking, and vertical members, such as posts, poles and columns.

- (f) **Stumps and roots.** All stumps and roots shall be removed from the soil to a depth of at least 12 inches below the surface of the ground in areas to be occupied by a building.
- (g) **Wood embedded in ground.** Where wood is embedded in or in contact with the ground for support of permanent structures, it shall have an approved pressure preservative treatment suitable for ground contact use, except where continuously below the ground water line or continuously submerged in fresh water. Round or rectangular posts, poles and sawn timber columns supporting permanent structures, which are embedded in concrete in direct contact with earth or embedded in concrete exposed to the weather, shall be approved pressure-treated wood.
- (h) **Wood in ground contact or exposed to the weather.** Posts or columns supporting permanent structures, which are closer than 8 inches to exposed ground in enclosed crawl spaces or unexcavated areas located within the periphery of the building, shall be approved wood of natural decay resistance or pressure-treated wood. Wood posts or columns exposed to the weather or in basement or cellars and that support permanent structures shall be supported by concrete piers or metal pedestals projecting at least 1 inch above concrete of masonry floors or decks and 6 inches above exposed earth and separated therefrom by an approved impervious barrier except when approved wood of natural decay resistance or pressure-treated wood is used.
- (i) **Glued-laminated timbers.** Those portions of glued-laminated timbers that form the structural supports of a building or other structure, and are exposed to weather and not properly protected by a roof, eave or similar covering shall be pressure preservatively treated or be manufactured from wood of natural resistance to decay.
- (j) **Crawl space construction.** Crawl spaces under buildings without basements shall be ventilated in accordance with this Section. Usable crawl spaces under buildings without basements shall be provided with a minimum of one access opening not less than 18 by 24 inches. Access openings shall be readily accessible and provided with a door or device that may be easily removed or operated. All wood framing and sheathing less than 8 inches from exposed earth in exterior walls that rest on treated wood, concrete or masonry foundations shall be approved naturally durable or pressure-treated wood. When the bottoms of wood structural floor elements, including joists, girders and subfloor, are less than 18 inches above the horizontal projection

of the outside grade level and extend toward the outside grade beyond the plane represented by the interior face of the foundation wall studs, such elements shall be approved naturally durable or pressure-treated wood. When wood joists or the bottom of wood structural floors without joists are closer than 18 inches, or wood girders are closer than 12 inches to exposed ground located within the periphery of the building over crawl space or unexcavated areas, they shall be of approved wood of natural decay resistance or pressure-treated wood.

- (k) **Crawl space ventilation.** Crawl spaces under buildings without basements shall be ventilated by approved mechanical means or by openings in foundation walls. Openings shall be arranged to provide cross ventilation and shall be covered with corrosion-resistant wire mesh of not less than $\frac{1}{4}$ inch, nor more than $\frac{1}{2}$ inch in any dimension. Openings in foundation walls shall not be less than the following:
 1. Such openings shall have a net area of not less than 1 square foot for each 150 square feet of crawl space.
 2. Where asphalt-saturated felt weighing 55 pounds per square, lapped at least 2 inches at joints, or 4 mil polyethylene lapped at least 4 inches at joints, or other approved vapor barrier is installed over the ground surface, the required net area of openings may be reduced to 10 percent of that required in Paragraph 1, and vents may have operable louvers. There shall be one ventilation opening within 3 feet of each corner.
- (l) **Wood in contact with concrete or masonry.** All wood in contact with concrete or masonry, including sills, sleepers, plates, posts, columns, beams, girders and furring, shall be treated with an approved preservative or shall be of a durable species, except that the ends of joists not less than 8 feet above the grade, when in contact with concrete or masonry, may be treated by dipping the ends in an approved preservative for a period of not less than 5 minutes.
- (m) **Moisture-permeable floors.** Wood structural members supporting moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, shall be of approved wood of natural resistance or pressure-treated wood, unless separated from such floors or roofs by an approved impervious moisture barrier.
- (n) **Walls.** Clearance between wood siding and earth on the exterior of a building shall be not less than 6 inches, except where siding, sheathing and wall framing are of approved pressure-treated wood or approved wood for natural resistance to termites.
- (o) **Wood girders.** Ends of wood girders entering exterior masonry or concrete walls shall be provided with $\frac{1}{2}$ -inch airspace on tops, sides and ends, unless approved naturally durable or pressure-treated wood is used.
- (p) **Furring strips.** Wood furring strips or other wood framing members attached directly to the interior of

exterior masonry or concrete walls below grade shall be approved naturally durable or pressure-treated wood.

- (q) **Crib or retaining walls.** Wood used in retaining or crib walls shall be approved pressure-treated wood.

Exceptions:

1. It may be of untreated wood when the wall is not more than 2 feet in height and is separated from the property line or a permanent building by a minimum distance equal to the height of the wall.
 2. It may be of approved naturally durable wood when the wall is not more than 2 feet in height and is located on the property line.
 3. It may be of durable wood when the wall is not more than 4 feet in height and is separated from the property line or a permanent building by a minimum distance equal to the height of the wall.
- (r) **Planter boxes.** There shall be not less than 4 inches of solid masonry or 3 inches of concrete between planter boxes and wood stud walls. The masonry or concrete shall extend to a height of not less than 6 inches above the outer wall of the planter. Solid sheathing and 15-pound asphalt-saturated felt or equivalent shall be installed between the masonry or concrete and the wood stud.

1010-9.601.4 Firestops. Firestopping shall be provided in accordance with the requirements of Subsection 707.9.

1010-9.601.5 Members entering masonry walls. Where joists, beams or girders enter and terminate in a masonry wall, they shall be beveled 3 inches minimum, so that the top edges enter the wall not more than 1 inch. If located in a required fire-resistive wall, members shall be separated from the opposite side of the wall by at least 4 inches of solid masonry, except on street fronts. The ends of wood members entering required fire-resistive masonry or concrete walls from opposite sides shall be separated by not less than 4 inches of solid masonry.

1010-9.601.6 Horizontal framing. Horizontal framing shall comply with the following requirements:

- (a) **Sills.** Sills, 2 inches minimum in thickness, shall be bolted to the foundation or foundation wall with not less than 1/2-inch-diameter bolts embedded at least 7 inches into the masonry or concrete and spaced not more than 4 feet apart. There shall be a minimum of two bolts per piece with one bolt located within 12 inches of each end of each piece.
- (b) **Built-up beams.** Laminated built-up beams with continuous lamination not less than 2 inches nominal thickness may be used in place of solid timbers when the face of laminations is parallel to the applied load. Laminated beams 10 inches or less deep may be spiked together with not less than 16d spikes at 12 inches centers, staggered. Unless so spiked, or if the depth of beam is more than 10 inches, the laminations shall be connected with bolts not smaller than 1/2-inch diameter, spaced not more than 2 feet apart, staggered or equal. Fastenings shall be placed at a maximum of

one-fourth the depth of the member from the top and bottom edges.

- (c) **End bearing.** Except where 2-inch members are supported on a 1-inch by 4-inch ribbon strip and nailed to the adjoining stud, the ends of each joist or rafter shall have not less than 1 1/2 inches of bearing on wood or metal, nor less than 3 inches on masonry, unless engineering calculations are submitted to show that lesser amounts are required.
- (d) **Members framing from opposite sides.** Rafters, joists and beams framing from opposite sides and on top of a beam, girder or partition shall be lapped at least 3 inches or the opposite joists shall be tied together by approved method.
- (e) **Header spans.** Header joists shall be doubled, or shall be of solid lumber of equivalent cross section, when the span of the header exceeds 4 feet. The ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers, unless bearing on a beam, partition or wall. Tail joists more than 12 feet long shall be supported by framing anchors or on ledger strips not less than 2 inches by 3 inches. All headers, beams, joists and studs shall be kept at least 2 inches from the outside face of chimney or fireplace masonry.
- (f) **Bearing partitions.** Bearing partitions parallel to joists shall be supported on built-up joists, beams, girders, walls or other bearing partitions. Bearing partitions perpendicular to joists shall not be offset from supporting members, walls or partitions more than the joist depth, except when engineering calculations are submitted to justify the offset.
- (g) **Rafters and floor joists.** Rafters more than 8 inches deep and floor joists more than 4 inches deep shall be stabilized against overturning or buckling from superimposed load, as follows:
1. At ends and at each support, by solid blocking not less than 2 inches thick and the full depth of joists, by nailing to studs when supported by ribbon boards, or by approved hangers or fastenings.
 2. Between supports, as required, so that joists will be stabilized every 8 feet and rafters every 10 feet by solid blocking 2 inches thick and full depth of the joist or rafter, or by wood cross bridging not less than 1 inch by 3 inches thick or by approved metal cross bridging.
 3. Where cross bridging is used, the lower ends of such bridging shall be driven up and nailed after the floor or subfloor has been nailed.
 4. Blocking and bridging of joists between supports may be eliminated for one-story buildings where joist depth does not exceed 12 inches and design live load is 50 pounds per square foot or less.

1010-9.601.7 Vertical framing. Vertical framing shall comply with the following requirements:

- (a) **Columns and posts.** All wood columns and posts shall be framed to true end bearings; shall extend down to supports of such design as to hold the column

or post securely in position and to protect its base from deterioration.

- (b) **Stud walls.** Studs in walls may be placed with their wide faces parallel to the wall when the studs are designed as columns. Stud walls shall have top and bottom plates.
- (c) **Exterior stud walls.** Exterior stud walls for buildings of two stories or less shall be of not less than 2-inch by 4-inch studs; for buildings of three stories, the studs shall be not less than 3 inches by 4 inches or 2 inches by 6 inches to the bottom of the second floor joists, and 2 inches by 4 inches for the two upper stories, except as otherwise provided.
- (d) **Unsupported height.** Unless designed in accordance with the requirements of Chapter 9, maximum unsupported height for stud framing shall be as follows:

**MAXIMUM UNSUPPORTED HEIGHT
FOR STUD FRAMING**

MAXIMUM UNSUPPORTED HEIGHT (feet)	SIZE OF STUD FRAMING (inches)
8	2 × 3
11	2 × 4
14	3 × 4
17	2 × 6

- (e) Studs shall be spaced not more than 16 inches on center.

Exceptions:

1. Studs 2 inches by 4 inches and wider may be spaced 24 inches on center when supporting a roof and ceiling only.
2. When engineering calculations are submitted to justify other spacing.

For maximum spacing of studs supporting gypsum lath, metal lath or gypsum wallboard, and other covering materials, see ASTM C926 (see EPCOT Standard 1007-1).

- (f) **Bracing.** Not less than three studs shall be installed at all corners and intersections of stud walls. Stud walls shall be effectively braced in accordance with Section 1010-9.501.
- (g) **Ties.** In bearing partitions and exterior walls, the top plates shall be doubled and lapped at each intersection with walls or partitions. Joints in the upper and lower members of the top plates shall be staggered not less than 4 feet. Other methods of providing a continuous tie at the top of walls may be used when approved by the Building Official.
- (h) **Foundation studs.** Studs between the foundation and the floor above shall be not less in size than the stud- ding above, shall be a minimum length of 14 inches and shall be effectively braced. When more than 4 feet high, studs shall be of the size required for an additional story.
- (i) **Openings.** Unless designed in accordance with Chapter 9, openings in bearing exterior walls shall have

double studs on each side of openings more than 3 feet wide and triple studs shall be provided on each side of openings more than 6 feet wide. Studs shall be continuous from floor to roof or floor to floor. Headers shall be provided over each openings in exterior-bearing walls and shall be designed in accordance with the requirements of this Code. Where the opening is more than 3 feet wide, each end of the header shall be supported on not less than one stud, and where the opening is more than 6 feet wide, each end shall be supported on not less than two studs, unless designed.

- (j) **Openings for pipes.** Stud partitions in which plumbing, heating or other pipes are placed shall be framed and the joists underneath shall be spaced to give required clearance for the piping. Where a partition containing such piping is parallel to the floor joists, the joists supporting the partition shall be doubled and spaced to permit passage of the pipes, and shall be bridged. Where plumbing, heating or other pipes are placed in or partly in a partition, requiring cutting the soles or plates, a metal tie not less than $\frac{1}{8}$ inch thick and $1\frac{1}{2}$ inches wide shall be fastened to the plate across and to each side of the opening, with not less than four 16d nails.
- (k) **Blocking.** All stud partitions or walls more than 8 feet high shall have blocking at mid-height or at intervals of not more than 10 feet. The blocking shall be not less than 2 inches thick and shall be the same width as the studs, fitted snugly and spiked into the studs, or other approved method shall be used to give lateral support to the studs. Blocking meeting the requirements of Subsection 707.9 shall be used.
- (l) **Water protection.** Where wood frame walls and partitions are covered on the interior with plaster, tile or other facings, and are subject to water splash, the framing shall be protected with approved water-resistant material.

SECTION 1010-9.701 LIGHT FRAMING

1010-9.701.1 Scope. The requirements of this Section are for light-frame construction in buildings housing Group R-3 and S occupancies, where the required floor live load is less than 50 psf and where the required roof live load does not exceed 20 psf. The details of this construction shall comply with the requirements of Subsections 1010-9.701.2 to 1010-9.701.8, inclusive.

1010-9.701.2 Joists and rafters. Joists and rafters selected from the American Forest & Paper Association (AF&PA) *Span Tables for Joists and Rafters* may be used in lieu of calculations, as required by other Subsections. Lumber specified by this method shall be grade marked accordingly.

1010-9.701.3 Fastenings. Fastenings for light framing shall comply with the following requirements:

- (a) **Size and number.** The number and size of nails connecting wood members shall be as specified in Table 1010-9.8.

- (b) **Subflooring.** Plywood subflooring and roof sheathing shall be nailed 6 inches on center at panel edges and boundary members, and 12 inches on center at intermediate supports.
- (c) **Mechanical fastenings.** Connections depending on joist hangers or framing anchors, ties and other mechanical fastenings may be used when approved by the Building Official.

1010-9.701.4 Floor framing. Floor framing for light-frame construction shall meet the following requirements:

- (a) **Girders.** Girders supporting first-floor joists shall be not less than 4 inches by 4 inches for spans 5 feet or less, or not less than 4 inches by 6 inches placed on edge for spans 7 feet or less. The ends of beams or girders supported on masonry or concrete shall have not less than 4 inches of bearing.
- (b) **Joists spans.** Spans for joists shall be in accordance with Paragraph (a).
- (c) **Subfloors.** Except when joist spacing is not more than 16 inches and nominal 1-inch tongue-and-grooved wood strips are applied perpendicular to the joist, one of the following subfloors shall be required.
 1. One-inch nominal, $\frac{3}{4}$ -inch minimum net sheathing applied perpendicular or diagonally to joists spaced 24 inches maximum on center. Joists shall occur over supports unless boards are end-matched wherein each board must be continuous over at least two joists.
 2. Plywood used as structural subflooring shall comply with the maximum span and identification index requirements shown in Table 1010-9.5 or combination subfloor underlayment shall have maximum spans in accordance with Table 1010-9.6.
- (d) **Plank and beam floors.** Floor systems of plank and beam construction may be designed as provided in this Standard, or in EPCOT Standard 1010-3. Joists in planking may be randomly spaced, provided that the system is applied to not less than three continuous spans; that planks are center-matched and end-matched or splined; that each plank bears on at least one support and joints are separated by at least 12 inches in adjacent pieces. One-inch-nominal strip square-edged flooring $\frac{1}{2}$ -inch tongue-and-grooved flooring shall be applied at right angles to the span of the plank. The $\frac{3}{8}$ -inch plywood shall be applied with the face grain at right angles to the span of the planks.

1010-9.701.5 Stair framing. Stair framing for light-frame construction shall be supported on floor framing or on walls or partitions. Not less than two stringers shall be provided for each set of stairs, cut to receive finish treads and risers of uniform width and height. Unless stringers are continuously supported on walls or partitions parallel to the stringer, the minimum effective depth at each notch shall be not less than $3\frac{1}{3}$ inches. Stringers shall be designed in accordance with the provisions of this Section, based on the net action. (See Section 806 for requirements for fire-protection of stairway construction.)

1010-9.701.6 Wall framing. The maximum unsupported height of studs shall be as specified in Subsection 1010-9.601.7(d).

1010-9.701.7 Nonbearing partitions. Framing for nonbearing partitions shall be of adequate size and spacing to support the finish applied thereto and the loads specified in Chapter 9.

1010-9.701.8 Roof and ceiling framing. Roof and ceiling framing in light-frame construction shall comply with the following requirements:

- (a) **Spans.** Spans for ceiling joists and rafters shall be in accordance with the requirements of Subsection 1010-9.701.2.
- (b) **Ridge members.** There shall be a ridge board at least 1 inch thick and not less in depth than the cut end of the rafter at all ridges. Where the slope of the roof is less than 3 in 12, the ridge member shall be designed as a vertical load-bearing member. At all valleys and hips, there shall be a double valley or a single hip rafter, each not less than 2 inches thick and not less in depth than the cut end of the rafter.
- (c) **Tie between exterior walls.** Where the ridge member is not designed as a vertical load-bearing member, rafters shall be framed directly opposite each other at the ridge and shall be nailed to adjacent ceiling joists to form a continuous tie between exterior walls. Where the ceiling joists run other than parallel to the rafters, rafters shall be tied across at or near their support by cross ties spaced not more than 48 inches on center, not less in size than 1 inch by 4 inches, or subflooring or metal straps shall be attached to the ends of the rafters to provide a continuous tie across the building.
- (d) **Purlins.** Purlins to support roof loads, that are installed to reduce the span of the rafters within permissible limits, shall be supported by struts from bearing walls or partitions. The maximum span of 2-inch by 4-inch purlins shall be 4 feet. The maximum span of 2-inch by 6-inch purlins shall be 6 feet. In no case shall the purlin be smaller than the size of the rafter supported. Struts shall not be smaller than 2 inches by 4 inches. The unbraced length of struts shall be 8 feet or less and the slope of the struts shall be not less than 45 degrees from the horizontal.
- (e) **Sheathing.** Rafters and roof joists shall be covered with sheathing conforming to the following requirements:

TYPE OF SHEATHING	MINIMUM THICKNESS (net - between joists)	MAXIMUM SPAN
Solid-straight	$\frac{5}{8}$	32
Solid-diagonal	$\frac{5}{8}$	24
Spaced	$\frac{3}{4}$	24

Plywood used as structural roof sheathing shall conform to the requirements for maximum spans and identification index set forth in Table 1010-9.5.

- (f) **Plank and beam roofs.** Roof systems of plank and beam construction shall conform to the requirements of AF&PA 1989 (see EPCOT Standard 1010-3).

- (g) **Trussed rafters.** The design of metal plate-connected wood roof trusses shall comply with EPCOT Standard 1010-31. Where trusses are to support mechanical or other equipment, the trusses shall be designed for such additional loads.

SECTION 1010-9.801 HEAVY TIMBER CONSTRUCTION

1010-9.801.1 Type III buildings. Buildings classified as heavy timber construction in accordance with Subsection 601.1(b) and Table 6.2 shall conform to the requirements of EPCOT Standard 1010-1 and this Section.

1010-9.801.2 Vertical framing. Vertical framing in heavy timber construction shall conform to the following requirements:

- (a) **Wood columns.** Wood columns may be sawn or glued laminated, and shall be not less than 8 inches nominal in any dimension when supporting roof or floor loads, except as specified in Subsections 1010-9.801.3(a) and 1010-9.801.3(b).
- (b) **Columns and beams.** Columns and beams shall be continuous, or shall be supported by direct bearing or heavy timber bolsters affixed to the columns by metal connectors housed within the contact faces, or by other approved methods.
- (c) **Trusses.** Framed timber trusses supporting floor loads shall have members of not less than 8 inches nominal in any dimension.
- (d) **Floors.** Floors shall be of sawn or glued-laminated plank, splined or tongue-and-grooved, not less than 3 inches nominal thick, covered with 1-inch-nominal dimension tongue-and-grooved flooring, laid cross-wise or diagonally; or shall be of planks not less than 4 inches nominal wide, set on edge close together and well spiked, and covered with 1-inch-nominal dimension flooring. The planks shall be laid so that no continuous line of joints shall occur except at points of support. Flooring shall not extend closer than $\frac{1}{2}$ inch to walls. The space between flooring and walls shall be covered by a molding fastened to the wall so that it will not obstruct the swelling or shrinking movement of the floor. Corbeling of masonry walls under floor planks may be used in place of such molding.
- (e) **Concealed spaces.** Floors shall be without concealed spaces.

1010-9.801.3 Roof framing. Roof framing for heavy timber construction shall conform to the following requirements:

- (a) **Arches.** Frames of glued-laminated arches for roof construction that spring from the top of the wall or wall abutment, framed timber trusses and other roof framing that does not support floor loads, shall have members not less than 4 inches nominal wide and not less than 6 inches nominal deep. Spaced members may be composed of two or more pieces not less than 3 inches nominal thick when blocked solidly throughout their intervening spaces. Splice plates shall be not less than 3 inches nominal thick.
- (b) **Roof decks.** Roof decks shall be sawn or glued-laminated, splined or tongue-and-grooved plank, not less than 2 inches nominal thick; or a double thickness of 1-inch-nominal boards with tongue-and-grooved joints or with staggered joints; or interior plywood (exterior glue) $1\frac{1}{8}$ inches thick; or of planks not less than 3 inches nominal wide set on edge close together and laid as required for floors. Other types of decking may be used when approved by the Building Official as alternatives under the provisions of Section 311.
- (c) **Concealed spaces.** Roofs shall be without concealed spaces.

1010-9.801.4 Mechanically laminated floor and roof decks. Laminated floor or roof decks built up of wood members set on edge may be designed as solid floors or roof decks of the same thickness, and continuous spans may be designed on the basis of the full cross section, using the simple span moment coefficient, when the roof deck or floor deck meet the following requirements:

- (a) **Nailing.** Laminations shall be driven up and spiked close together with a row of nails near each edge at spaced intervals and staggered vertically. Nail spacing in each row shall not exceed 18 inches for 2-inch by 8-inch nominal width and shall be proportional for other plank widths. Nail lengths shall be not less than $2\frac{1}{2}$ times the net thickness of each lamination.
- (b) **Splicing.** A single-span deck shall have full-length laminations. A continuous two-span deck shall have not more than every fourth lamination spliced within quarter points adjoining supports. A continuous deck of more than two spans shall have not more than every third lamination spliced within quarter points adjoining supports. No lamination shall be spliced more than twice in any span.
- (c) **Joints.** Joints shall be closely butted over supports or staggered across the deck, but within the adjoining quarter span.

1010-9.801.5 Construction details. Heavy timber construction shall also meet the following requirements:

- (a) **Plate boxes or hangers.** Approved wall plate boxes or hangers shall be provided where wood beams, girders or trusses rest on masonry or concrete walls. An airspace of $\frac{1}{2}$ inch shall be provided at the top, end and sides of the member, unless approved durable species or treated wood is used.
- (b) **Girders and beams.** Girders and beams shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or inter-tied by caps or ties, to transfer horizontal loads across the joint. Wood bolsters may be placed on top of columns that support roof loads only.
- (c) **Intermediate beams.** Where intermediate beams support a floor, they shall rest on top of the girders, or they shall be supported by ledgers or blocks securely fastened to the sides of the girders, or they may be supported by approved metal hangers into which the ends of the beams shall be closely fitted.

- (d) **Anchorage of girders.** Every roof girder and at least alternate roof beams shall be anchored to their supporting members. Where supported by a wall, roof planking shall be anchored to the wall at intervals of

not more than 20 feet. Monitor and sawtooth construction shall be anchored to the main roof construction. Anchors shall be of sufficient strength to resist vertical uplift of the roof.

**TABLE 1010-9.8
FASTENING SCHEDULE**

CONNECTION	FASTENING ^{a, m}	LOCATION
1. Joist to sill or girder	3 - 8d common (2½" × 0.131") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail
2. Bridging to joist	2 - 8d common (2½" × 0.131") 2 - 3" × 0.131" nails 2 - 3" 14 gage staples	toenail each end
3. 1" × 6" subfloor or less to each joist	2 - 8d common (2½" × 0.131")	face nail
4. Wider than 1" × 6" subfloor to each joist	3 - 8d common (2½" × 0.131")	face nail
5. 2" subfloor to joist or girder	2 - 16d common (3½" × 0.162")	blind and face nail
6. Sole plate to joist or blocking Sole plate to joist or blocking at braced wall panel	16d (3½" × 0.135") at 16" o.c. 3" × 0.131" nails at 8" o.c. 3" 14 gage staples at 12" o.c. 3" - 16d (3½" × 0.135") at 16" 4 - 3" × 0.131" nails at 16" 4 - 3" 14 gage staples per 16"	typical face nail braced wall panels
7. Top plate to stud	2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	end nail
8. Stud to sole plate	4 - 8d common (2½" × 0.131") 4 - 3" × 0.131" nails 3 - 3" 14 gage staples 2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail end nail
9. Double studs	16d (3½" × 0.135") at 24" o.c. 3" × 0.131" nails at 8" o.c. 3" 14 gage staples at 8" o.c.	face nail
10. Double top plates Double top plates	16d (3½" × 0.135") at 16" o.c. 3" × 0.131" nails at 12" o.c. 3" 14 gage staples at 12" o.c. 8 - 16d common (3½" × 0.162") 12 - 3" × 0.131" nails 12 - 3" 14 gage staples	typical face nail lap splice
11. Blocking between joists or rafters to top plate	3 - 8d common (2½" × 0.131") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail
12. Rim joist to top plate	8d (2½" × 0.131") at 6" o.c. 3" × 0.131" nails at 6" o.c. 3" 14 gage staples at 6" o.c.	toenail
13. Top plates, laps and intersections	3 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	face nail
14. Continuous header, two pieces	3 - 16d common (3½" × 0.162")	16" o.c. along edge
15. Ceiling joists to plate	3 - 8d common (2½" × 0.131") 5 - 3" × 0.131" nails 5 - 3" 14 gage staples	toenail
16. Continuous to stud	4 - 8d common (2½" × 0.131")	toenail
17. Ceiling joists, laps over partitions	3 - 16d common (3½" × 0.162") minimum 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail

(continued)

**TABLE 1010-9.8—continued
FASTENING SCHEDULE**

CONNECTION	FASTENING ^{a, m}	LOCATION
18. Ceiling joists to parallel rafters	3 - 16d common (3½" × 0.162") minimum 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
19. Rafter to plate	2 - 8d common (2½" × 0.131") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail
20. 1" diagonal brace to each stud and plate	2 - 8d common (2½" × 0.131") 2 - 3" × 0.131" nails 3 - 3" 14 gage staples	face nail
21. 1" × 8" sheathing to each bearing	3 - 8d common (2½" × 0.131")	face nail
22. Wider than 1" × 8" sheathing to each bearing	3 - 8d common (2½" × 0.131")	face nail
23. Built-up corner studs	16d common (3½" × 0.162") 3" × 0.131" nails 3" 14 gage staples	24" o.c. 16" o.c. 16" o.c.
24. Built-up girder and beams	20d common (4" × 0.192") 32" o.c. 3" × 0.131" nails at 24" o.c. 3" 14 gage staples at 24" o.c. 2 - 20d common (4" × 0.192") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	face nail at top and bottom staggered on opposite sides face nail at ends and at each splice
25. 2" planks	16d common (3½" × 0.162")	at each bearing
26. Collar tie to rafter	3 - 10d common (3" × 0.148") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
27. Jack rafter to hip	3 - 10d common (3" × 0.148") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples 2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail face nail
28. Roof rafter to 2-by ridge beam	2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples 2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail face nail
29. Joist to band joist	3 - 16d common (3½" × 0.162") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
30. Ledger strip	3 - 16d common (3½" × 0.162") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
31. Wood structural panels and particleboard ^b Subfloor, roof and wall sheathing (to framing)	½" and less 6d ^{c, l} 2⅜" × 0.113" nail ⁿ 1⅜" 16 gage ^o 15/32" to 19/32" 8d common [roofs in 110-140 mph (Exp. B)] 19/32" to ¾" 8d ^d or 6d ^e 2⅜" × 0.113" nail ^p 7/8" to 1" 2" 16 gage ^p 8d ^e 1⅛" to 1¼" 10d ^d or 8d ^d ¾" and less 6d ^e 7/8" to 1" 8d ^e 1⅛" to 1¼" 10d ^d or 8d ^e	6" o.c. along edges and inter- mediate, 4" o.c. at component and cladding edge strip #3 [refer to Figure 6-3 of ASCE 7]
Single floor (combination subfloor-underlay- ment to framing)		

(continued)

**TABLE 1010-9.8—continued
FASTENING SCHEDULE**

CONNECTION	FASTENING ^{a, m}		LOCATION
32. Panel siding (to framing)	$\frac{1}{2}$ " or less $\frac{5}{8}$ "	6d ^f 8d ^f	
33. Fiberboard sheathing ^g	$\frac{1}{2}$ " $\frac{25}{32}$ "	No. 11 gage roofing nail ^h 6d common nail (2" × 0.113") No. 16 gage staple ⁱ No. 11 gage roofing nail ^h 8d common nail (2½" × 0.131") No. 16 gage staple ⁱ	
34. Interior paneling	$\frac{1}{4}$ " $\frac{3}{8}$ "	4d ^j 6d ^k	

- a. Common or box nails are permitted to be used, except where otherwise stated.
- b. Nails spaced at 6 inches on center at edges, 12 inches at intermediate supports, except 6 inches at supports where spans are 48 inches or more. For nailing of wood structural panel and particleboard diaphragms and shear walls, refer to Section 1010-9.501. Nails for wall sheathing are permitted to be common, box or casing.
- c. Common or deformed shank (6d - 2" × 0.113"; 8d - 2½" × 0.131"; 10d - 3" × 0.148").
- d. Common (6d - 2" × 0.113"; 8d - 2½" × 0.131"; 10d - 3" × 0.148").
- e. Deformed shank (6d - 2" × 0.113"; 8d - 2½" × 0.131"; 10d - 3" × 0.148").
- f. Corrosion-resistant siding (6d - 1⅞" × 0.106"; 8d - 2⅜" × 0.128") or casing (6d - 2" × 0.099"; 8d - 2½" × 0.113") nail.
- g. Fasteners spaced 3 inches on center at exterior edges and 6 inches on center at intermediate supports, when used as structural sheathing. Spacing shall be 6 inches on center on the edges and 12 inches on center at intermediate supports for nonstructural applications.
- h. Corrosion-resistant roofing nails with ⅞-inch-diameter head and 1½-inch length for ½-inch sheathing and 1¾-inch length for ⅝-inch sheathing.
- i. Corrosion-resistant staples with nominal ⅞-inch crown and 1⅞-inch length for ½-inch sheathing and 1½-inch length for ⅝-inch sheathing. Panel supports at 16 inches (20 inches if strength axis in the long direction of the panel, unless otherwise marked).
- j. Casing (1½" × 0.080") or finish (1½" × 0.072") nails spaced 6 inches on panel edges, 12 inches at intermediate supports.
- k. Panel supports at 24 inches. Casing or finish nails spaced 6 inches on panel edges, 12 inches at intermediate supports.
- l. For roof sheathing applications, 8d nails (2½" × 0.113") are the minimum required for wood structural panels.
- m. Staples shall have a minimum crown width of ⅞ inch.
- n. For roof sheathing applications, fasteners spaced 4 inches on center at edges, 8 inches at intermediate supports.
- o. Fasteners spaced 4 inches on center at edges, 8 inches at intermediate supports for subfloor and wall sheathing and 3 inches on center at edges, 6 inches at intermediate supports for roof sheathing.
- p. Fasteners spaced 4 inches on center at edges, 8 inches at intermediate supports.

SECTION 1010-9.901 FIRE-RETARDANT-TREATED WOOD

1010-9.901.1 Fire-retardant-treated wood. Fire-retardant-treated wood is any wood product which, when impregnated with chemicals by a pressure process or other means during manufacture, shall have, when tested in accordance with ASTM E84 or UL 723, a listed flame spread index of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional 20-minute period. Additionally, the flame front shall not progress more than 10½ feet beyond the centerline of the burners at any time during the test.

1010-9.901.1.2 Pressure process. For wood products impregnated with chemicals by a pressure process, the process shall be performed in closed vessels under pressures not less than 50 pounds per square inch gauge (psig).

1010-9.901.1.3 Other means during manufacture. For wood products produced by other means during manufacture, the treatment shall be an integral part of the manufacturing process of the wood product. The treatment shall provide permanent protection to all surfaces of the wood product.

1010-9.901.1.4 Testing. For wood products produced by other means during manufacture, other than a pressure process, all sides of the wood product shall be tested in accordance with and produce the results required in Subsection 1010-9.901.1. Wood structural panels shall be permitted to test only the front and back faces.

1010-9.901.1.5 Labeling. Fire-retardant-treated lumber and wood structural panels shall be labeled. The label shall contain the following items:

1. The identification mark of an approved agency in accordance with Subsection 1010.3(f).
2. Identification of the treating manufacturer.
3. The name of the fire-retardant treatment.
4. The species of wood treated.
5. Flame spread and smoke-developed index.
6. Method of drying after treatment.
7. Conformance to appropriate standards in accordance with Subsections 1010-9.901.1.6 through 1010-9.901.1.9.
8. For fire-retardant-treated wood exposed to weather, damp or wet locations, include the words "No

increase in the listed classification when subjected to the Standard Rain Test” (ASTM D2898).

1010-9.901.1.6 Strength adjustments. Design values for untreated lumber and wood structural panels, as specified in Subsection 1010-9.201.1(d), shall be adjusted for fire-retardant-treated wood. Adjustments to design values shall be based on an approved method of investigation that takes into consideration the effects of the anticipated temperature and humidity to which the fire-retardant-treated wood will be subjected, the type of treatment and redrying procedures.

1010-9.901.1.6.1 Wood structural panels. The effect of treatment and the method of redrying after treatment, and exposure to high temperatures and high humidities on the flexure properties of fire-retardant-treated softwood plywood shall be determined in accordance with ASTM D5516. The test data developed by ASTM D5516 shall be used to develop adjustment factors, maximum loads and spans, or both, for untreated plywood design values in accordance with ASTM D6305. Each manufacturer shall publish the allowable maximum loads and spans for service as floor and roof sheathing for its treatment.

1010-9.901.1.6.2 Lumber. For each species of wood that is treated, the effects of the treatment, the method of redrying after treatment and exposure to high temperatures and high humidities on the allowable design properties of fire-retardant-treated lumber shall be determined in accordance with ASTM D5664. The test data developed by ASTM D5664 shall be used to develop modification factors for use at or near room temperature and at elevated temperatures and humidity in accordance with ASTM D6841. Each manufacturer shall publish the modification factors for service at temperatures of not less than 80°F and for roof framing. The roof framing modification factors shall take into consideration the climatological location.

1010-9.901.1.7 Exposure to weather, damp or wet locations. Where fire-retardant-treated wood is exposed to weather, or damp or wet locations, it shall be identified as “Exterior” to indicate there is no increase in the listed flame spread index as defined in Subsection 1010-9.901.1 when subjected to ASTM D2898.

1010-9.901.1.8 Interior applications. Interior fire-retardant-treated wood shall have moisture content of not over 28 percent when tested in accordance with ASTM D3201 procedures at 92-percent relative humidity. Interior fire-retardant-treated wood shall be tested in accordance with Subsection 1010-9.901.1.6.1 or 1010-9.901.1.6.2. Interior fire-retardant-treated wood designated as Type A shall be tested in accordance with the provisions of this Section.

1010-9.901.1.9 Moisture content. Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for wood structural panels before use. For wood kiln-dried after treatment (KDAT), the kiln temperatures shall not exceed those used in kiln-drying the lumber and plywood submitted for the

tests described in Subsection 1010-9.901.1.6.1 for plywood and Subsection 1010-9.901.1.6.2 for lumber.

1010-9.901.1.10 Type I and II construction applications. See Section 602 for limitations on the use of fire-retardant-treated wood in buildings of Type I or II construction.

1010-9.901.2 Identification. All fire-retardant-treated wood shall bear an identification mark showing the flame spread index thereof issued by an approved agency having a reexamination service. Fire-retardant-treated wood shall bear the quality mark of an approved inspection agency that maintains continued supervision and inspection over the method of drying. The drying shall be done according to the EPCOT Standard 1010-21(c) for lumber and EPCOT Standard 1010-21(d) for plywood.

Where fire-retardant-treated wood is exposed to weather, it shall be further identified to indicate that there is no increase in the listed flame spread index as defined above when subjected to EPCOT Standard 1010-21(a).

Where experience has demonstrated a specific need for use of material of low hygroscopicity, fire-retardant-treated wood to be subjected to high humidity conditions shall be identified to indicate the treated wood has a moisture content of not more than 28 percent when tested in accordance with EPCOT Standard 1010-21(b) procedures at 92-percent relative humidity.

1010-9.901.3 Moisture content. Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for plywood before use.

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EPCOT

ELECTRICAL CODE

2018 EDITION

**AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT**

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EPCOT ELECTRICAL CODE 2018 EDITION



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ARTICLE 80

ADMINISTRATION

80.1 Scope. The provisions of this Code shall apply as set forth in Article 90.2 of the *National Electrical Code* (NEC).

80.2 Definitions. The following words and phrases, when used in this Code, shall have the meaning as indicated in this Section:

- (a) **Chief Electrical Inspector.** The duly appointed individual who shall be responsible for the issuance of electrical permits and the inspection of all authorized work thereunder.
- (b) **Electrical construction.** Installation, demolition, remodeling, repair or extension of any materials used in systems of electrical wiring for light, alarm, heat, power, signaling, remote control, power-limited, solar photovoltaic, electronic computer/data processing and/or communication circuits, and all equipment used in connection therewith.
- (c) **Electrical Contractor.** A person, firm or corporation engaging in the business of electrical construction. The person in charge of the electrical installations for such person, firm or corporation shall be qualified as a master electrician according to the provisions of this Code, and shall possess a valid master electrician's Certificate of Competency.
- (d) **National Electrical Code.** The *National Electrical Code*, 2014 Edition, as published by the National Fire Protection Association (NFPA) and further identified as ANSI/NFPA 70—2014 by the American National Standards Institute (ANSI).

80.3 Purpose. The purpose of this Code is to provide a uniform minimum standard regulating and providing requirements for safe and stable installations, methods of construction and uses of compatible materials in electrical wiring, apparatus or equipment used for light, heat, power, signal, remote control, power-limited and communication circuits. These rules and regulations are intended to be used in combination with the NEC, said code being hereby adopted and made a part of this Code as if fully set out herein. Where conflict in interpretation or intent are noted between this Code and the NEC, this Code shall be the governing document. New electrical systems, apparatus or parts thereof, or additions, alterations, repair or changes to existing systems or apparatus or equipment shall conform to the requirements of this Code.

80.4 Organization.

- (a) **Creation of an Electrical Division.** There is hereby created in the Department of Building and Safety of the Reedy Creek Improvement District (the District), the Electrical Division, which shall be responsible to the Building Official.
- (b) **Appointment of Chief Electrical Inspector.** The Building Official shall appoint a Chief Electrical Inspector. Such person shall have not less than 10 years

experience in charge of installation and/or inspection of electrical construction. The Chief Electrical Inspector shall serve under the direction of the Building Official.

- (c) **Restriction on employees.** No officer or employee connected with the Electrical Division shall be financially interested in the furnishing of labor, material or appliances for the construction, alteration or maintenance of electrical installations, or in the making of plans or of specifications therefore, unless he is the owner of such building. No such officer or employee shall engage in any work that is inconsistent with his duties or with the interests of the Department.

80.7 Title. The Chapters and Articles of this volume shall constitute and be known as the *EPCOT Electrical Code*.

80.8 Safety, responsibility and application.

- (a) **Safety.** All electrical equipment shall be so constructed, installed, protected, operated and maintained that said electrical equipment will be to such extent as is reasonably possible, safe and free from danger of accident or injury by shock, fire or otherwise to either person or property.
- (b) **Responsibility.** This Code shall not be construed to relieve from or lessen the responsibility of any party owning, operating, controlling or installing any electric wiring, electric devices or electric material for damages to person or property caused by any defect therein, nor shall the jurisdiction be held as assuming any such liability by reason of any inspection authorized herein, or Certificate of Inspection issued as herein provided.
- (c) **Application.** All provisions and requirements of all Articles, Sections and Subsections of the NEC, which are not herein expressly amended or superseded, shall be deemed to be in full force and effect; and if there is not contained herein any specific reference to any electrical work or equipment or other matter covered by the NEC, then the applicable requirements of said code, with respect to such electrical work or equipment or other matter, shall be complied with.

80.13 Powers and duties of the Chief Electrical Inspector.

- (a) **Inspection and enforcement.** It shall be the duty of the Chief Electrical Inspector to inspect all electrical construction within the limits of the District, and to enforce the rules and regulations of this Code.
- (b) **Right of entry.** Whenever necessary to make an inspection to enforce the requirements of this Code, and/or whenever the Chief Electrical Inspector has reason to believe that there exists in any building or on any premises electrical construction that creates an unsafe condition, the building or premises shall be made accessible at reasonable times to inspect the installation or to perform a duty imposed by this Code. If the building or premises is occupied, the Chief Elec-

trical Inspector shall first present his credentials and request entry. If entry is refused, he shall report that fact to the Building Official who shall determine what action is to be taken under the requirements of the *EPCOT Building Code*.

(c) **Stop work orders.** Whenever any work is being done contrary to the provisions of this Code, or is being done in any unsafe or dangerous manner, the Chief Electrical Inspector may order such work stopped or may order the violation corrected by notice, in writing, served on the person(s) engaged in doing or causing such work to be done. Such person(s) shall immediately stop the work until authorized to resume such work by the Chief Electrical Inspector.

(d) **Authority to condemn electrical construction.** Whenever the Chief Electrical Inspector learns that an electrical system or equipment regulated by this Code has become hazardous to life, health or property, he shall order, in writing, that the electrical system or equipment be removed or corrected. No person shall use or maintain defective equipment after written notice has been received from the Chief Electrical Inspector. Failure to comply with the notice shall cause the system to be abated in accordance with the procedure established in the *EPCOT Building Code*.

(e) **Unsafe or dangerous wiring.** The Chief Electrical Inspector or his designated representative is hereby empowered to inspect or reinspect all wires and apparatus conducting or using electrical current for light, heat, power, signaling, remote control, power-limited, communication circuits, and when conductors or apparatus are found to be unsafe to life or property, he shall notify the owner of the premises to place the same in a safe and secure condition within 24 hours or within such further time as the Chief Electrical Inspector shall reasonably determine is necessary. Whenever any wiring, apparatus or fixture conducting or using current for light, heat, power, signaling, remote control, power-limited and communication circuits is found to be especially or immediately hazardous to life and/or property, the Chief Electrical Inspector shall post in a conspicuous place near such switches or circuit breakers a notice, printed in red letters, as follows:

“**Notice—wiring condemned.** The use of electric current is prohibited through this wiring or equipment until proper repairs have been made and approved by the Chief Electrical Inspector. Repairs must be made under a master electrician’s supervision, and the Chief Electrical Inspector must be notified when completed.” After such notice is posted, no person shall close the switch or circuit breaker that has been opened by the Chief Electrical Inspector, or use or attempt to use any current through such wiring, apparatus or fixture that has been condemned until necessary repairs have been made and approved by the Chief Electrical Inspector. The Chief Electrical Inspector may also notify the utility company to disconnect the service.

(f) **Alternative materials and systems of construction.**

1. **Alternatives permitted.** The requirements of this Code are not intended to prevent the use of systems, materials or methods of design or installation as alternatives to the standards specified in this Code. Such alternatives may be offered for approval and their consideration shall be in accordance with the requirements of Section 204 of the *EPCOT Building Code*.

2. **Testing.** The Chief Electrical Inspector shall require that documented proof be submitted to substantiate a claim made regarding the use of alternative materials, systems or methods of design or installation. Whenever there is insufficient evidence to substantiate such claim, the Chief Electrical Inspector may require tests in accordance with the requirements of Subsection 204.4 of the *EPCOT Building Code*.

3. **Modifications.** In cases where installation problems or conditions arise that were clearly not contemplated in the making of these regulations and that make literal application manifestly impractical, the Building Official may, by special permission in writing and in advance, allow such modification of the detailed requirements of such rule as may be justified by the conditions, provided the work is done in accordance with the spirit and intent of the rule and in such manner as to afford an equal or greater degree of safety.

(g) **Requirements not covered by Code.** Any requirements necessary for the safety or stability of an existing or proposed building, structure or other electrical installation, or the occupants/users thereof, not specifically covered by this Code, shall be determined by the Chief Electrical Inspector.

(h) **Interference with electrical inspections.** It shall be unlawful for any person to hinder or interfere with the Chief Electrical Inspector or his designated representative in the discharge of his duties under the provisions of this Code.

80.15 Board of Appeals.

(a) **Creation of the Board Of Appeals.** The Board of Appeals established by the *EPCOT Building Code* shall serve as the Board of Appeals when requests for use of alternative materials, systems or methods of design or installation of electrical wiring, devices or equipment for light, heat or power have been rejected by the Chief Electrical Inspector. The same Board of Appeals shall provide a reasonable interpretation of this Code when an appeal from the decision of the Chief Electrical Inspector has been filed.

80.18 Electrical Contractors.

(a) **Qualification requirements.** Prior to engaging in the business of electrical contracting within the District, a person, firm or corporation shall satisfy the Chief Electrical Inspector that he is or has in his employ a properly registered or certified Electrical Contractor.

- (b) **Certification/registration.** Electrical Contractors shall be properly registered with or certified by the Florida Electrical Contractors Licensing Board, and all certified shall possess a current Orange County Certificate of Competency.
- (c) **Identification.** The Electrical Contractor may be the company owner, proprietor, an employee or corporation officer, but shall, in all cases, be the person who is directly responsible for the physical and mechanical manner in which electrical construction is performed.
- (d) **Responsibility.** Each electrical permit application shall be signed by an Electrical Contractor. The same Electrical Contractor shall directly supervise and be responsible for all electrical construction authorized by such permit.
- (e) **Termination of responsibility.** An Electrical Contractor may be relieved from his responsibilities under any permit signed by him after written notice is filed with the Chief Electrical Inspector and prior to the completion of electrical construction covered by said permit. When the Electrical Contractor terminates his services voluntarily or otherwise, it shall be his responsibility to notify the Chief Electrical Inspector within 24 hours, exclusive of Saturdays, Sundays and holidays.
- (f) **Use of name.** It shall be unlawful for an Electrical Contractor to allow his name to be used by any person or party, directly or indirectly, either for the purpose of obtaining a permit or to do any work under his license that he will not directly supervise.
- (g) **Supervision.** All electrical construction shall be supervised by the responsible Electrical Contractor whose name appears on the electrical permit for such work.

80.19 Permits and approvals.

- (a) **Permit required.** No person, firm or corporation shall install or remove any wiring or devices, or equipment for heat, light, power, signaling, remote control, alarm, solar photovoltaic systems, power-limited, electronic computer/data processing equipment and/or communication circuits, for temporary or permanent purposes, within the District, or cause the same to be done, without first obtaining from the Department of Building and Safety an electrical permit for such work. Application shall be submitted to the Department of Building and Safety on a form provided by the District and shall bear the signature of the Electrical Contractor who will be directly responsible for the work. The application shall be accompanied by two complete sets of plans, specifications and schedules as may be necessary to determine whether the installation, as described, will be in compliance with the requirements of this Code.
- (b) **Inspections.** The following paragraphs indicate those phases of electrical construction for which there are required inspections. It shall be the responsibility of the Electrical Contractor whose name appears on the electrical permit to notify the office of the Chief Electrical Inspector for these inspections. A period of 24 hours, exclusive of Saturdays, Sundays and holidays,

will be required from the time the request is made in which to perform the inspection and report.

1. **Electrical underground.** When conduit and/or conductors are buried or conduit is encased in foundations or slabs (i.e., buried perimeter grounds and their connections; driven ground rods; PVC installations; conduit and outlet boxes in poured slabs, walls, ceilings, etc.), all rebar, plumbing and other piping or tube work shall be in place on work to be concealed before the electrical work is inspected, and no such work shall be considered as complete until all such plumbing or piping is in place. Upon making an inspection of any electrical work or equipment, when the same is found to have been installed in a satisfactory manner and in accordance with the provisions of this Code, the Chief Electrical Inspector shall sign the inspection record card that the electrical work herein inspected was found to be in accordance with the provisions of this Code. It shall be unlawful to lath, seal or in any manner conceal any electrical work or equipment until the same has been inspected and the permit card signed as herewith required. It shall be unlawful to cover or fill any switch or outlet box with plaster, cement or other materials.
2. **Rough-in (raceways).** When all conduit, pull boxes, fittings, empty panelboards, etc., have been mounted and prior to the pulling of any conductors.
3. **Rough-in (wiring).** After all conductors have been pulled and panelboards have been fitted out, including load centers, motor control centers, motor starters, time clocks, distribution and/or lighting and appliance panelboards, etc. All lighting fixture boxes, receptacle boxes and switch boxes shall be empty with a minimum of 6-inch lengths of the required conductors exposed in each. In all cases, these conductors shall be of sufficient length to readily make a positive identification of all required conductor jacketing information.
4. **Final electrical.** Final inspection shall be made upon completion of the job with all fixtures, fuses, wiring, receptacles, switches, lamps, etc., in place. It shall be the responsibility of the Electrical Contractor whose name appears on the electrical permit to insure that any electrical installation is not energized until the installation has passed final inspection by the Chief Electrical Inspector.
5. **Progress inspections.** The inspection procedure outlined in this Article represents an ideal situation. However, numerous area inspections may be required and shall be requested when necessary as construction progresses, so as to prevent any work from being covered without inspection.

- (c) **Expiration.** A permit issued under the provisions of this Code shall expire by limitation and become null and void when the work covered by the permit has not been started within 180 days from the date of issuance of the permit; or when the work is suspended or abandoned at any time for 180 days. Before such work can proceed, a new permit shall first be obtained in accordance with the requirements of this Section and a fee shall be paid in the amount of the original total permit fee.
- (d) **Suspension or revocation.** The Chief Electrical Inspector may, in writing, suspend or revoke a permit issued under the provisions of this Code when the permit has been issued in error or was based on incorrect information supplied by the applicant, or when the work being done is in violation of the requirements of this Code, the *EPCOT Building Code* or the Land Use Regulations of the District.

80.21 Approval of plans and specifications.

- (a) **Applicable regulations.** When plans and specifications have been approved, the issuance of a permit shall not prevent the Chief Electrical Inspector from hereafter requiring correction of errors in such plans and specifications or from preventing electrical installations being made thereunder in violation of this Code or of any other regulations of the District applicable thereto. Compliance with this Code is the responsibility of the owner or his authorized agent.
- (b) **Required information.** All electrical plans shall include a one-line riser diagram showing wire sizes and types, conduit sizes and types, distances and fault currents available at all panels, transformers, motor control centers and main service equipment.

80.23 Notice of violations, penalties.

- (a) **Violations and penalties.** A person, firm, corporation or agent who shall violate any requirement of this Code, or who shall fail to comply therewith, or who shall install, alter, repair, remove or maintain equipment regulated by this Code in violation of a detailed statement or drawing submitted and approved by the Chief Electrical Inspector, shall be guilty of a misdemeanor and shall be subject to the penalty provided in Section 67-764, Laws of Florida, Special Acts of 1967.

80.29 Liability. An officer or employee of the District charged with the enforcement of this Code shall not thereby render himself personally liable and he is hereby relieved from all personal liability for any damage that may accrue to persons or property as a result of an act required or permitted in the discharge of his duties, in accordance with the *EPCOT Building Code*.

80.31 Validity. If any Section, Subsection, sentence or phrase of this Code is, for any reason, held to be unconstitutional, such decision shall not affect the validity of remaining parts of this Code.

CHAPTER 1

GENERAL

ARTICLE 110 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

110.1 See Subsections 503.7(f) and 805.9, and EPCOT Standard 5-12 of the *EPCOT Building Code*; Subsection 505.15 of the *EPCOT Mechanical Code*; and Section 610 of the *EPCOT Fuel Gas Code*.

110.2 Electrical equipment room.

- (a) **Equipment.** The electrical equipment room is dedicated to disconnecting means, meter(s), time clocks, step-down transformers, panelboards, etc. No other equipment, except a telephone terminal board that must be in a separate area from the electrical equipment, shall be allowed in this room.
- (b) **Storage.** There shall be no storage in this room, and a durable, waterproof sign with letters not less than $\frac{1}{2}$ inch high shall be mounted on the outside of the door reading: "ELECTRICAL EQUIPMENT ROOM—NO STORAGE PERMITTED."

CHAPTER 2

WIRING AND PROTECTION

ARTICLE 210 BRANCH CIRCUITS

210.1 Minimum number of receptacle outlets. Offices less than 100 square feet shall have a minimum of one outlet. Offices larger than 100 square feet shall have a minimum of one outlet on each of two opposing walls.

210.2 Stairway lighting. Stairway lighting shall be controlled by 3- or 4-way switches located at the top and bottom of the stairway, except in multiple dwellings or apartments, or other public buildings where the stair lighting is controlled on special hall, corridor or house circuits that are energized at all hours of darkness (see Article 404.2 of the NEC).

ARTICLE 225 OUTDOOR WIRING AND EQUIPMENT

225.1 Minimum mounting height. Panelboards, disconnects, switches and similar electrical equipment installed outdoors shall be at least 24 inches above finished floor measured from the bottom of the cabinet.

225.2 Overhead wiring. Overhead power lines shall only be allowed for temporary installation with prior, written approval of the Chief Electrical Inspector in each case.

ARTICLE 230 SERVICES AND FEEDERS

230.1 Power distribution. Since the characteristics of the service available in different localities within the District may vary, it is recommended that the responsible design personnel contact the utility company and verify location and type of power available at any specific site, prior to preparation of construction documents.

230.2 Change load. On all wiring installations where an increase or decrease of load beyond the approved designed capacities is to be made, the utility company shall be notified before the change occurs.

230.3 Energizing circuits. A sticker, bearing the approval of the Department of Building and Safety, shall be placed upon the main disconnect housing before any electrical circuits, temporary or permanent, may be energized.

230.4 Service point. The point-of-service entrance to buildings shall be determined by the serving utility, or public service corporation or agency.

230.5 Meters owned by the utility company. In no case shall an electrical meter owned and installed by the utility company be removed or changed by anyone other than a representative of that company.

230.6 Main disconnects.

- (a) **Residential buildings.** A fused main disconnect switch or circuit breaker with a minimum rating of 100

amperes shall be installed on the exterior of the building, or in a utility room or garage.

- (b) **Small residential buildings.** For residences not exceeding 600 square feet of living area and loads not exceeding 5,000 volt-amperes, based on 200 volt-amperes per 120-volt current consuming outlet, plus maximum volt-amperes for direct connected loads, the minimum may be 60 amps and the service conductors not less than 6 American Wire Gauge (AWG) copper or equal ampacity.

- (c) **Commercial buildings.** A fused main disconnect switch or circuit breaker with a minimum rating of 100 amperes shall be installed on the outside of the building as near the point of entrance of service conductors as possible considering the type of building and accessibility in case of fire or other reason for opening the service switch and disconnecting the building. Upon special application to the Chief Electrical Inspector, before any work is started, written approval may be granted for the meter and mains to be installed inside the building, if accessible and available for meter reading, servicing and disconnecting in case of emergencies.

- (d) **Interior disconnects.** On all buildings, except one- and two-family dwellings, if the main switch is not readily apparent on the exterior of the building, a shunt trip switch shall be installed on the exterior of the building mounted at 7 feet above the finished floor or grade. This requirement shall also apply to buildings served by feeders. The shunt trip switch shall be properly identified by a reasonable sign constructed of permanent materials with not less than 2-inch-high letters.

- (e) **Concession carts.** Each concession cart shall have a shunt trip button or other disconnecting means within 6 feet of the operator's station. Pressing the button or opening the switch shall disconnect the electrical supply to the cart.

230.7 Grounded service required. All service conductors shall include a grounded conductor from the point of service to the service disconnecting means.

230.8 Tap. No conductor shall be tapped off of the service entrance conductors ahead of the main overcurrent protective device on a structure without prior written permission from the Chief Electrical Inspector.

ARTICLE 250 GROUNDING AND BONDING

250.1 Grounding conductors. An equipment grounding conductor shall be installed within all feeder and branch circuit raceways. The size of the conductor shall not be less than given in Table 250-122 of the NEC.

CHAPTER 3

WIRING METHODS AND MATERIALS

ARTICLE 300 FLEXIBLE CONDUIT

300.1 Restriction. Flexible conduit longer than 6 feet in length may be used only with the prior written approval of the Chief Electrical Inspector.

ARTICLE 310 CONDUCTORS

310.1 Color code. The ungrounded conductors of the different voltage systems in the following list shall be identified by using colored wire insulation with the following colors: 120 volts, single phase, 2 wire: black 240/120 volts; single phase, 3 wire: black and red 480/240 volts; single phase, 2 wire: brown and yellow 240 volts; 3 phase, 3-wire delta: black, red and blue 240/120 volts; 3 phase, 4 wire, high-leg delta: black, red and orange (high-leg) 208Y/120 volts; 3 phase, 4 wire: black, red and blue 480Y/277 volts; 3 phase, 4 wire: brown, orange and yellow 480 volts; 3 phase, 3-wire delta: brown, orange and yellow. The grounded conductor for the 120-, 208-, 240-volt system shall be white, and for the 480-, 277-volt systems shall be gray. Switch legs may be any other color, except those specified for other voltage classifications, and grounded and grounding conductors. AWG sizes four and larger may be identified by means of colored tape or other permanent and substantial means of color coding.

310.2 Identification. Prior to installation of conductors, means shall be provided to ensure that conductor ends are identified at each end as phase, grounded or grounding conductors. Prior to energizing conductors, verification that each conductor is identically identified at each end shall be required.

ARTICLE 352 RIGID NONMETALLIC CONDUIT

352.1 Limitation. Rigid nonmetallic conduit is the only raceway or conduit that shall be permitted to be installed in direct contact with earth, or in areas subject to severe corrosive influences (see Article 300.6 of the NEC).

ARTICLE 358 ELECTRICAL METALLIC TUBING

358.1 Restriction. Electrical metallic tubing shall not be used in unsuspended concrete slabs on ground floors, underground, or in Class I, II or III hazardous locations as defined in the NEC.

ARTICLE 362 ELECTRICAL NONMETALLIC TUBING

362.1 Expanded scope. The use of electrical nonmetallic tubing (ENT) shall be allowed in those areas covered by Arti-

cles 518 and 520 of the NEC, provided the installation is in accordance with Article 362 of the NEC.

ARTICLE 398 OPEN WIRING ON INSULATORS

398.1 Limited use. Article 398 of the NEC in its entirety will apply only for temporary construction or for special purposes approved, in writing, by the Chief Electrical Inspector prior to issuance of construction permit.

CHAPTER 4

EQUIPMENT FOR GENERAL USE

ARTICLE 404 SWITCHES

404.1 Wall switches in bathrooms. Wall switches will be permitted within reach of a bathtub or shower if no other place in the bathroom is suitable as long as the switch is not placed within the area of the tub or shower. Metal pull chains are prohibited in these locations. Receptacles are not permitted within reach from bathtub and shower.

ARTICLE 408 SWITCHBOARDS AND PANELBOARDS

408.1 Electric fused switches, switchboards and panelboards. Electric fused switches, switchboards and panelboards shall not be permitted to be installed in any private bathroom or public restroom.

ARTICLE 410 LIGHTING FIXTURES

410.1 Inspection sequence. Provisions for compliance with Article 410.66 of the NEC shall be verified at the time of rough-in inspection.

ARTICLE 422 APPLIANCES

422.1 Multiple feeds to equipment. Where any electrical equipment receives electrical energy from more than one source, it shall be provided with disconnecting means from each source of electrical energy immediately adjacent to the equipment served. All electrical equipment connected from more than one source of electrical energy shall have permanent signs affixed with letters not less than 1/2 inch high, reading: "DANGER THIS EQUIPMENT HAS MORE THAN ONE SOURCE OF POWER."

ARTICLE 430 MOTORS

430.1 Motor disconnect location. Section 430.102 of the NEC, "Motor Not in Sight from Controller," shall be amended as follows: Where a motor and the driven machinery are not in sight from the controller location, a manually operable switch or a controller disconnecting means capable of being locked in the open position that will disconnect the motor and the driven machinery control equipment from its source of supply shall be placed within sight from the motor location. "Within sight" shall be interpreted the same as Article 440.1.

ARTICLE 440 HEATING, AIR CONDITIONING AND REFRIGERATION

440.1 Disconnecting means. A disconnecting means shall be installed within sight and readily accessible, in the ungrounded leads of each power circuit to all electric furnaces, duct heaters, compressors, condensing units and air-handling units. A light outlet with fixture and guarded lamp, and a duplex receptacle shall be installed within 3 feet of the servicing side of heating and air-conditioning equipment in low attics, crawl spaces and isolated equipment spaces where mechanical equipment will need servicing and there are no other easily reachable sources of light and power receptacles. Where roof-mounted mechanical equipment is installed, no light fixture is required. For roof-mounted units, a duplex receptacle shall be within 25 feet of the service side of all units. For the purpose of this Code, "within sight" is interpreted to be visible within 50 feet, and "readily accessible" is interpreted to be capable of being reached quickly for operation, renewal or inspections without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc., as referenced in Article 100 of the NEC, Definitions.

ARTICLE 450 TRANSFORMERS

450.1 Ratings. Prior to the installation of any power transformer used for lighting and general receptacle use, documentation shall be provided to the Chief Electrical Inspector that the transformer is suitable for the usage. Especially taking into account nonlinear loads and the required "K" rating of transformers as referenced in Articles 110.3 and 110.10 of the NEC.

CHAPTER 5

SPECIAL OCCUPANCIES

ARTICLE 590 TEMPORARY INSTALLATION PERMITS

590.1 Permit required. An electrical permit shall be required for each temporary installation and all associated electrical wiring. Application shall be made to the Department of Building and Safety and shall state the size, the proposed use, the location, and bear the signature of the responsible Electrical Contractor. The permit shall be posted at the power source or the first disconnecting means enclosure.

590.2 Duration. Temporary installations shall be permitted for a specified period of time, not to exceed 90 days unless specifically authorized in writing by the Chief Electrical Inspector.

590.3 Identification. All portable temporary electrical equipment shall be clearly labeled, so as to identify the owner or party responsible for the installation and condition of the equipment.

590.4 New construction. Temporary power for structures under construction shall be subject to the following restrictions. Violations of any of the restrictions shall result in the immediate termination of power.

- (a) **Complete installation.** The electrical distribution system shall be substantially completed. All panels and overcurrent devices shall be installed, and all conductors pulled and terminated.
- (b) **Lockable equipment.** All panels not in equipment rooms shall have lockable covers or enclosures.
- (c) **Keys to equipment.** Only the Electrical Contractor holding the permit for the job may have keys to the equipment rooms or panels. The owner and/or general contractor shall not have access to these areas once power is turned on.
- (d) **Supervised access.** Should it be necessary for personnel who are not employees of the Electrical Contractor to have access to an equipment room or panel, one of the Electrical Contractors' personnel shall be in the room at all times when any work is performed in the electrical room.
- (e) **Restricted/controlled access.** Electrical equipment rooms and energized panels shall be kept closed and locked at all times when Electrical Contractors' personnel are not in the room.
- (f) **Liability.** The Electrical Contractor understands that he assumes full liability for any hazards, damages or injuries caused by the power being on, and that the District assumes no liability for the power or any damages that may result from the use thereof.
- (g) **Request form.** Written request for temporary power on the structure shall be made on a form provided by the District and signed by the designated parties, including the Electrical Contractor, owner and general

contractor, stating they understand the requirements of this Code.

CHAPTER 6

SPECIAL EQUIPMENT

ARTICLE 600

ELECTRIC SIGNS AND OUTLINE LIGHTING

600.1 Listing. Any sign or device containing neon or neon components shall be listed by an approved testing laboratory. All portions of UL 48, and Articles 410 and 600 of the NEC shall be followed for any device using neon lighting.

ARTICLE 680

SWIMMING POOLS, FOUNTAINS AND SIMILAR INSTALLATIONS

680.1 Lighting fixtures. Article 680.20 of the NEC is amended as follows: Paragraphs (a) through (c) of this Section apply to all lighting fixtures installed below the normal water level of the pool. All lighting fixtures shall be installed for operation at 15 volts or less between conductors.

680.2 Emergency switch for spas and hot tubs. Article 680.41 of the NEC, Exception: An emergency switch for spas and hot tubs shall not be required for gravity feed systems that do not present entrapment hazards and that comply with Florida Administrative Code 64E-9.

CHAPTER 7

SPECIAL CONDITIONS

ARTICLE 700 EMERGENCY SYSTEMS

700.1 Emergency lighting. Emergency lighting and/or exit lights shall be installed where designated by the Building Official as set forth in the *EPCOT Building Code* and must conform with Article 700 of the NEC. Every building that is required to have emergency lighting systems shall be tested and inspected annually by the District, the Department of Building and Safety, and the Reedy Creek Department of Emergency Services.

700.2 Dimmers. Egress illumination (emergency lighting) required by Subsection 813.2 of the *EPCOT Building Code* may be controlled by switches and/or dimmers when approved by the Building Official in accordance with this Article. When approved, in addition to the requirements of this Article, all of the following shall apply:

- (a) Dimmers and/or switches shall be automatically overridden with loss of normal power and/or with any fire alarm activation,
- (b) Dimmer system shall not automatically reset after activation. A manual reset feature shall be provided,
- (c) An engineering analysis is required for the devices used to ensure proper operation and compatibility.

Exception: Switches permitted in NEC Article 700.21.

700.3 Dimmer system. A dimmer system containing more than one dimmer and listed for use in emergency systems may be permitted in accordance with Article 700.2 to be used as a control device for energizing emergency lighting circuits. On failure of normal power and activation of any fire alarm initiating device, the dimmer system shall be permitted to energize those circuits required to provide emergency lighting levels established by the *EPCOT Building Code*. All branch circuits supplied by the dimmer system cabinet shall comply with the wiring methods of Article 700 of the NEC.

ARTICLE 705 INTERCONNECTED ELECTRIC POWER PRODUCTION SOURCES

705.1 Current supplied from private sources. All wiring or apparatus for light, heat or power in premises of any nature that is to be supplied with current from a private source, furnished by means of generator sets or otherwise, may be arranged and connected so as to operate on any approved system of wiring, whether AC or DC, two, three or four wire, subject to all provisions of this Code, and subject to the provision that such wiring, arrangement and connection shall be compatible with the utility company.

ARTICLE 760 FIRE ALARM SYSTEMS

760.1 Surge arresters. All fire alarm panels shall have a surge arrester installed to protect the system. The device shall be listed and labeled by a nationally recognized testing laboratory.

760.2 Submittals. All contractors, individuals or corporate entities installing any alarm system of any type (fire, burglar, security, equipment sensors) shall furnish to the District the following information prior to the issuance of a permit: Drawings for the system, documentation of the listing by an approved third-party testing agency of the system components and the system as a complete unit. Final inspection will not be made until the Chief Electrical Inspector has witnessed an operational test of the system, inspected the installation and received as designed drawings of the system.

760.3 Color coding. All raceways and junction/pull boxes containing fire alarm circuits shall be painted red and the box covers shall be clearly and permanently marked "F/A."

EPCOT

ENERGY EFFICIENCY CODE FOR BUILDING CONSTRUCTION 2018 EDITION

AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT

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P.O. BOX 10170
LAKE BUENA VISTA, FL
32830

INTERNATIONAL CODE COUNCIL®

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Since 1967
Reedy Creek

EPCOT

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FOR BUILDING CONSTRUCTION
2018 EDITION

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EPCOT ENERGY EFFICIENCY CODE FOR BUILDING CONSTRUCTION 2018 EDITION



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PREFACE

Introduction

Internationally, Code Officials recognize the need for a modern, up-to-date *energy* code addressing the design and installation of systems through requirements emphasizing performance. The *EPCOT Energy Efficiency Code for Building Construction* is designed to meet these needs through model code regulations that safeguard the public's health and safety in all communities, large and small.

This comprehensive *energy* code establishes minimum regulations for systems using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new *gas* system designs.

Marginal Markings

Solid vertical lines in the margins within the body of this Code indicate a change from the requirements of the 2015 edition, except where a change was minor. Deletion indicators (■) are provided in the margin where *an entire section*, paragraph, *exception or table* has been deleted if the deletion resulted in a change of requirements.

Maintenance

The *EPCOT Energy Efficiency Code for Building Construction* is kept up to date through the review of proposed changes submitted by code enforcement officials, industry representatives, design professionals and other interested parties. Proposed changes are carefully considered through an open code development process in which all interested and affected parties may participate.

While the development procedure of the *EPCOT Energy Efficiency Code for Building Construction* assures the highest degree of care, those participating in the development of this Code do not accept any liability resulting from compliance or non-compliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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CHAPTER 1 [CE]

SCOPE AND ADMINISTRATION

PART 1—SCOPE AND APPLICATION

SECTION C101 SCOPE AND GENERAL REQUIREMENTS

C101.1 Title. This Code shall be known as the *EPCOT Energy Efficiency Code for Building Construction*, and shall be cited as such. It is referred to herein as “this Code.”

C101.2 Scope. This Code applies to commercial buildings and the buildings’ sites and associated systems and equipment.

C101.3 Intent. This Code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This Code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This Code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

C101.4 Applicability. Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

C101.4.1 Mixed occupancy. Where a building includes both residential and commercial occupancies, each occupancy shall be separately considered and meet the applicable provisions of this Code.

C101.4.2 Exempt buildings. Buildings exempt from the provisions of this Code, include existing buildings except those considered renovated buildings, changes of occupancy type or previously unconditioned buildings to which comfort conditioning is added. Exempt buildings include those specified in Subsections C101.4.2.1 through C101.4.2.4.

C101.4.2.1 Federal standards. Any building for which federal mandatory standards preempt state energy codes.

C101.4.2.2 Historic buildings. Any building meeting the criteria for historic buildings as defined in Chapter 2 of this Code.

C101.4.2.3 Low-energy buildings as described in Subsection C402.1.1. Such buildings shall not contain electrical, plumbing or mechanical systems which have been designed to accommodate the future installation of heating or cooling equipment.

C101.4.2.4 Buildings designed for purposes other than general space comfort conditioning. Any build-

ing where heating or cooling systems are provided which are designed for purposes other than general space comfort conditioning. Buildings included in this exemption include:

1. Commercial service areas where only ceiling radiant heaters or spot coolers are to be installed which will provide heat or cool only to a single work area and do not provide general heating or cooling for the space.
2. Buildings heated with a system designed to provide sufficient heat only to prevent freezing of products or systems. Such systems shall not provide heating above 50°F (10°C).
3. Premanufactured freezer or refrigerated storage buildings and areas where the temperature is set below 40°F (4°C) and in which no operators work on a regular basis.
4. Electrical equipment switching buildings which provide space conditioning for equipment only and in which no operators work on a regular basis except that the provisions of Section C405 shall apply.
5. Buildings containing a system(s) designed and sold for dehumidification purposes only and controlled only by a humidistat. No thermostat shall be installed on systems thus exempted from this Code.

C101.4.3 Limited or special use buildings. Buildings determined by the Building Official to have a limited energy use potential based on size, configuration or time occupied, or to have a special use requirement shall be considered limited or special use buildings. Code compliance requirements may be adjusted by the Building Official to handle such cases when nationally recognized energy analysis procedures have been used to demonstrate that the building would use less energy than a code compliant building of the same configuration.

C101.5 Compliance. Residential buildings shall meet the Residential Provisions of this Code. Commercial buildings shall meet the Commercial Provisions of this Code.

C101.5.1 Compliance materials. The Florida Building Commission shall approve specific computer software. The Building Official shall be permitted to approve worksheets, compliance manuals and other similar materials that meet the intent of this Code.

C101.5.1.1 Alterations, renovations and building systems. Alterations, renovations and building systems may utilize Form C402. Form C402 can be found in Appendix CA.

SECTION C102 ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

C102.1 General. This Code is not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the Building Official as meeting the intent of this Code.

C102.1.1 Above code programs. The Building Official or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this Code. Buildings approved in writing by such an energy efficiency program shall be considered in compliance with this Code. The requirements identified as “mandatory” in Chapter 4 shall be met.

PART 2—ADMINISTRATION AND ENFORCEMENT

SECTION C103 CONSTRUCTION DOCUMENTS

C103.1 General. Construction documents and other supporting data shall be submitted in one or more sets with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the Building Official is authorized to require necessary construction documents to be prepared by a registered design professional.

Exception: The Building Official is authorized to waive the requirements for construction documents or other supporting data if the Building Official determines they are not necessary to confirm compliance with this Code.

C103.1.1 Compliance certification.

C103.1.1.1 Code compliance demonstration.

C103.1.1.1.1 Residential. See *EPCOT Energy Efficiency Code for Building Construction—Residential Provisions*.

C103.1.1.1.2 Commercial and multiple-family residential. Completion of procedures demonstrating compliance with this Code for commercial and multiple-family residential buildings shall be in accordance with the provisions of Section 481.229, *Florida Statutes*, or Section 471.003, *Florida Statutes*.

Exception: Where HVAC systems are ≤ 15 tons per system, air conditioning or mechanical contractors licensed in accordance with Chapter 489, *Florida Statutes*, or commercial building energy raters certified in accordance with Section 553.99, *Florida Statutes*, may prepare the code compliance form.

Design professionals responsible under Florida law for the design of lighting, electrical, mechanical,

and plumbing systems and the building shell, shall certify compliance of those building systems with the code by signing and providing their professional registration number on the energy code form provided as part of the plans and specifications to the building department.

C103.1.1.2 Code compliance certification. The building’s owner, the owner’s architect, or other authorized agent legally designated by the owner shall certify that the building is in compliance with the code, as per Section 553.907, *Florida Statutes*, prior to receiving the permit to begin construction or renovation.

C103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted where approved by the Building Official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Insulation materials and their *R*-values.
2. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
3. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water heating system and equipment types, sizes and efficiencies.
6. Economizer description.
7. Equipment and system controls.
8. Fan motor horsepower (hp) and controls.
9. Duct sealing, duct and pipe insulation and location.
10. Lighting fixture schedule with wattage and control narrative.
11. Location of daylight zones on floor plans.
12. Air sealing details.

C103.2.1 Building thermal envelope depiction. The building’s thermal envelope shall be represented on the construction drawings.

C103.3 Examination of documents. The Building Official shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this Code and other pertinent laws or ordinances. The Building Official is authorized to utilize a registered design professional, or other approved entity not affiliated with the building design or construction, in conducting the review of the plans and specifications for compliance with the code.

C103.3.1 Approval of construction documents. When the Building Official issues a permit where construction documents are required, the construction documents shall

be endorsed in writing and stamped “Reviewed for Code Compliance.” Such approved construction documents shall not be changed, modified or altered without authorization from the Building Official. Work shall be done in accordance with the approved construction documents.

One set of construction documents so reviewed shall be retained by the Building Official. The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the Building Official or a duly authorized representative.

C103.3.2 Previous approvals. This Code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this Code and has not been abandoned.

C103.3.3 Phased approval. The Building Official shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or approved, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this Code. The holders of such permit shall proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

C103.4 Amended construction documents. Changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.

C103.5 Retention of construction documents. One set of approved construction documents shall be retained by the Building Official for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

SECTION C104 INSPECTIONS

C104.1 General. Construction or work for which a permit is required shall be subject to inspection by the Building Official or his or her designated agent, and such construction or work shall remain accessible and exposed for inspection purposes until approved. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Neither the Building Official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this Code.

C104.2 Required inspections. The Building Official or his or her designated agent, upon notification, shall make the inspections set forth in Subsections C104.2.1 through C104.2.6.

C104.2.1 Footing and foundation inspection. Inspections associated with footings and foundations shall verify compliance with the code as to *R*-value, location, thick-

ness, depth of burial and protection of insulation as required by the code and approved plans and specifications.

C104.2.2 Framing and rough-in inspection. Inspections at framing and rough-in shall be made before application of interior finish and shall verify compliance with the code as to types of insulation and corresponding *R*-values and their correct location and proper installation; fenestration properties (*U*-factor, SHGC and VT) and proper installation; and air leakage controls as required by the code and approved plans and specifications.

C104.2.3 Plumbing rough-in inspection. Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding *R*-values and protection; required controls; and required heat traps.

C104.2.4 Mechanical rough-in inspection. Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC equipment type and size; required controls, system insulation and corresponding *R*-value; system and damper air leakage; and required energy recovery and economizers.

C104.2.5 Electrical rough-in inspection. Inspections at electrical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed lighting systems, components and controls; and installation of an electric meter for each dwelling unit.

C104.2.6 Final inspection. The building shall have a final inspection and shall not be occupied until approved. The final inspection shall include verification of the installation and proper operation of all required building controls, and documentation verifying activities associated with required building commissioning have been conducted and findings of noncompliance corrected. Buildings, or portions thereof, shall not be considered for a final inspection until the Building Official has received a letter of transmittal from the building owner acknowledging that the building owner has received the Preliminary Commissioning Report as required in Subsection C408.2.4.

C104.3 Reinspection. A building shall be reinspected when determined necessary by the Building Official.

C104.4 Approved inspection agencies. The Building Official is authorized to accept inspection reports in whole or in part from either individuals as defined in Section 553.993(5) or (7), *Florida Statutes* or third-party inspection agencies not affiliated with the building design or construction, provided such agencies are approved as to qualifications and reliability relevant to the building components and systems they are inspecting.

C104.5 Inspection requests. It shall be the duty of the holder of the permit or their duly authorized agent to notify the Building Official when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this Code.

C104.6 Reinspection and testing. Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made to achieve compliance with this Code. The work or installation shall then be resubmitted to the Building Official for inspection and testing.

C104.7 Approval. After the prescribed tests and inspections indicate that the work complies in all respects with this Code, a notice of approval shall be issued by the Building Official.

C104.7.1 Revocation. The Building Official is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this Code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise, or portion thereof is in violation of any ordinance or regulation or any of the provisions of this Code.

SECTION C105 VALIDITY

C105.1 General. If a portion of this Code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this Code.

SECTION C106 REFERENCED STANDARDS

C106.1 Referenced codes and standards. The codes and standards referenced in this Code shall be those listed in Chapter 6, and such codes and standards shall be considered as part of the requirements of this Code to the prescribed extent of each such reference and as further regulated in Subsections C106.1.1 and C106.1.2.

C106.1.1 Conflicts. Where conflicts occur between provisions of this Code and referenced codes and standards, the provisions of this Code shall apply.

C106.1.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this Code, the provisions of this Code, as applicable, shall take precedence over the provisions in the referenced code or standard.

C106.2 Application of references. References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this Code.

C106.3 Other laws. The provisions of this Code shall not be deemed to nullify any provisions of local, state or federal law.

SECTION C107 FEES RESERVED

SECTION C108 STOP WORK ORDER

C108.1 Authority. Where the Building Official finds any work regulated by this Code being performed in a manner either contrary to the provisions of this Code or dangerous or unsafe, the Building Official is authorized to issue a stop work order.

C108.2 Issuance. The stop work order shall be in writing and shall be given to the owner of the property involved, the owner's authorized agent, or to the person doing the work. Upon issuance of a stop work order, the cited work shall immediately cease. The stop work order shall state the reason for the order and the conditions under which the cited work will be permitted to resume.

C108.3 Emergencies. Reserved.

C108.4 Failure to comply. Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be subject to penalties as prescribed by law.

SECTION C109 BOARD OF APPEALS RESERVED

CHAPTER 2 [CE]

DEFINITIONS

SECTION C201 GENERAL

C201.1 Scope. Unless stated otherwise, the following words and terms in this Code shall have the meanings indicated in this Chapter.

C201.2 Interchangeability. Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

C201.3 Terms defined in other codes. Terms that are not defined in this Code but are defined in the *EPCOT Building Code*; *EPCOT Fire Prevention Code*; *EPCOT Fuel Gas Code*; *EPCOT Mechanical Code*; or *EPCOT Plumbing Code* shall have the meanings ascribed to them in those codes.

C201.4 Terms not defined. Terms not defined by this Chapter shall have ordinarily accepted meanings such as the context implies.

SECTION C202 GENERAL DEFINITIONS

ABOVE-GRADE WALL. See “Wall, above-grade.”

ACCESSIBLE. Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see “Readily accessible”).

ADDITION. An extension or increase in the conditioned space floor area or height of a building or structure.

ADJACENT WALL, CEILING or FLOOR. A wall, ceiling or floor of a structure that separates conditioned space from enclosed but unconditioned space, such as an unconditioned attached garage, storage or utility room.

AEROSOL SEALANT. A closure product for duct and plenum systems, which is delivered internally to leak sites as aerosol particles using a pressurized air stream.

AIR BARRIER. Relating to air distribution systems, a material object(s) that impedes or restricts the free movement of air under specified conditions. For fibrous glass duct, the air barrier is its foil cladding; for flexible nonmetal duct, the air barrier is the nonporous core; and for sheet metal duct and air handling units, the air barrier is the metal in contact with the air stream. For mechanical closets, the air barrier may be a uniform panelized material such as gypsum wallboard that meets ASTM C36, or it may be a membrane that alone acts as an air barrier that is attached to a panel, such as the foil cladding of fibrous glass duct board. Relating to the building envelope, air barriers comprise the planes of primary resistance to airflow between the interior spaces of a building and the outdoors and the planes of primary airflow resistance between adjacent air zones of a building, including planes between adjacent conditioned and unconditioned air spaces of a building. To be classed as an air barrier, a building plane

must be substantially leak free; that is, it shall have an air leakage rate not greater than 0.5 cfm/ft² when subjected to an air pressure gradient of 25 pascal. In general, air barriers are made of durable, nonporous materials and are sealed to adjoining wall, ceiling or floor surfaces with a suitable long-life mastic. House wraps and taped and sealed drywall may constitute an air barrier, but dropped acoustical tile ceilings (T-bar ceilings) may not. Batt insulation facings and asphalt-impregnated fiberboard and felt paper are not considered air barriers.

AIR CONDITIONING. The treatment of air so as to control simultaneously the temperature, humidity, cleanness and distribution of the air to meet the requirements of a conditioned space.

AIR CURTAIN. A device, installed at the building entrance, that generates and discharges a laminar air stream intended to prevent the infiltration of external, unconditioned air into the conditioned spaces, or the loss of interior, conditioned air to the outside.

AIR DISTRIBUTION SYSTEM. Any system of ducts, plenums and air-handling equipment that circulates air within a space or spaces and includes systems made up of one or more air-handling units.

ALTERATION. Any construction, retrofit or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

APPROVED. Approval by the Building Official as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the Building Official.

ATTIC. An enclosed unconditioned space located immediately below an uninsulated roof and immediately above the ceiling of a building.

AUTOMATIC. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see “Manual”).

BELOW-GRADE WALL. See “Wall, below-grade.”

BOILER, MODULATING. A boiler that is capable of more than a single firing rate in response to a varying temperature or heating load.

BOILER SYSTEM. One or more boilers, their piping and controls that work together to supply steam or hot water to heat output devices remote from the boiler.

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BRITISH THERMAL UNIT (Btu). Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (454 g) of water 1°F (0.56°C) (1 Btu = 1055 J).

BUBBLE POINT. The refrigerant liquid saturation temperature at a specified pressure.

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy. For each purpose of this Code, each portion of a building separated from other portions by a firewall shall be considered as a separate building. The term “building” shall be construed as if followed by the words “or part thereof.”

BUILDING COMMISSIONING. A process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner’s project requirements and construction documents, and to minimum code requirements.

BUILDING ENTRANCE. Any door, set of doors, doorway, or other form of portal that is used to gain access to the building from the outside by the public.

BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this Code, or a duly authorized representative.

BUILDING SITE. A contiguous area of land that is under the ownership or control of one entity.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space. See “Adjacent wall, ceiling or floor.”

C-FACTOR (THERMAL CONDUCTANCE). The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces ($\text{Btu/h} \cdot \text{ft}^2 \cdot ^\circ\text{F}$) [$\text{W}/(\text{m}^2 \cdot \text{K})$].

CIRCULATING HOT WATER SYSTEM. A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to the fixture supply and back to the water-heating equipment.

CLIMATE ZONE. A geographical region based on climatic criteria as specified in this Code.

COEFFICIENT OF PERFORMANCE (COP) – COOLING. The ratio of the rate of heat input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

COEFFICIENT OF PERFORMANCE (COP) – HEATING. The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system, including the compressor and, if applicable, auxiliary heat, under designated operating conditions.

COMMERCIAL BUILDING. For this Code, all buildings that are not included in the definition of “Residential building.”

COMPUTER ROOM. A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power density exceeding 20 watts per square foot of conditioned floor area.

CONDENSING UNIT. A factory-made assembly of refrigeration components designed to compress and liquefy a specific refrigerant. The unit consists of one or more refrigerant compressors, refrigerant condensers (air-cooled, evaporatively cooled, or water-cooled), condenser fans and motors (where used) and factory-supplied accessories.

CONDITIONED FLOOR AREA. The horizontal projection of that portion of space that is conditioned directly or indirectly by an energy-using system.

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces; where they are separated from conditioned spaces by uninsulated walls, floors or ceilings; or where they contain uninsulated ducts, piping or other sources of heating or cooling. See “Space.”

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.

CONTROL. To regulate the operation of equipment.

CONTROL DEVICE. A specialized device used to regulate the operation of equipment.

CRAWL SPACE WALL. The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

DAYLIGHT RESPONSIVE CONTROL. A device or system that provides automatic control of electric light levels based on the amount of daylight in a space.

DAYLIGHT ZONE. That portion of a building’s interior floor area that is illuminated by natural light.

DEMAND CONTROL VENTILATION (DCV). A ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

DEMAND RECIRCULATION WATER SYSTEM. A water distribution system where pumps prime the service hot water piping with heated water upon demand for hot water.

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

DYNAMIC GLAZING. Any fenestration product that has the fully reversible ability to change its performance properties, including *U*-factor, solar heat gain coefficient (SHGC), or visible transmittance (VT).

ECONOMIZER, AIR. A duct and damper arrangement and automatic control system that allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

ECONOMIZER, WATER. A system where the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

EFFICIENCY. Performance at specified rating conditions.

ENCLOSED SPACE. A volume surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows.

ENERGY. The capacity for doing work. It takes a number of forms that may be transformed from one into another such as thermal (heat), mechanical (work), electrical and chemical. Customary measurement units are British thermal units (Btu).

ENERGY ANALYSIS. A method for estimating the annual energy use of the proposed design and standard reference design based on estimates of energy use.

ENERGY COST. The total estimated annual cost for purchased energy for the building functions regulated by this Code, including applicable demand charges.

ENERGY RECOVERY VENTILATION SYSTEM. Systems that employ air-to-air heat exchangers to recover energy from exhaust air for the purpose of preheating, precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

ENERGY SIMULATION TOOL. An approved software program or calculation-based methodology that projects the annual energy use of a building.

ENTRANCE DOOR. Fenestration products used for ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances that utilize latching hardware and automatic closers and contain over 50-percent glass specifically designed to withstand heavy use and possibly abuse.

EQUIPMENT. Devices for comfort conditioning, electric power, lighting, transportation or service water heating including, but not limited to, furnaces, boilers, air conditioners, heat pumps, chillers, water heaters, lamps, luminaires, ballasts, elevators, escalators or other devices or installations.

EQUIPMENT ROOM. A space that contains either electrical equipment, mechanical equipment, machinery, water pumps or hydraulic pumps that are a function of the building's services.

EXTERIOR WALL. Walls including both above-grade walls and basement walls that form a boundary between a conditioned and an outdoor space.

FAN BRAKE HORSEPOWER (BHP). The horsepower delivered to the fan's shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

FAN EFFICIENCY GRADE (FEG). A numerical rating identifying the fan's aerodynamic ability to convert shaft power, or impeller power in the case of a direct-driven fan, to air power.

FAN SYSTEM BHP. The sum of the fan brake horsepower of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and return it to the source or exhaust it to the outdoors.

FAN SYSTEM DESIGN CONDITIONS. Operating conditions that can be expected to occur during normal system operation that result in the highest supply fan airflow rate to conditioned spaces served by the system.

FAN SYSTEM MOTOR NAMEPLATE HP. The sum of the motor nameplate horsepower of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned spaces and return it to the source or exhaust it to the outdoors.

FENESTRATION. Products classified as either vertical fenestration or skylights.

Skylight. Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal. Glazing materials in skylights, including unit skylights, tubular daylighting devices, solariums, sunrooms, roofs and sloped walls are included in this definition.

Vertical fenestration. Windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of at least 60 degrees (1.05 rad) from horizontal.

FENESTRATION AREA. Total area of the fenestration measured using the rough opening and including the glazing, sash and frame. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area.

FENESTRATION PRODUCT, FIELD-FABRICATED. A fenestration product whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration.

FENESTRATION PRODUCT, SITE-BUILT. A fenestration designed to be made up of field-glazed or field-assembled units using specific factory cut or otherwise factory-

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formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls and atrium roof systems.

F-FACTOR. The perimeter heat loss factor for slab-on-grade floors (Btu/h · ft · °F) [W/(m · K)].

FLOOR AREA, NET. The actual occupied area not including unoccupied accessory areas such as corridors, stairways, toilet rooms, mechanical rooms and closets.

GASKETING. A compressible, resilient elastic packing, made of foam rubber or of a synthetic foam polymer. A gasket is distinct from the components being joined and must be capable of closing all air leakage pathways between the air barriers of the joint and of creating an air-tight seal.

GENERAL LIGHTING. Lighting that provides a substantially uniform level of illumination throughout an area. General lighting shall not include decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.

GENERAL PURPOSE ELECTRIC MOTOR (SUBTYPE I). A motor that is designed in standard ratings with either of the following:

1. Standard operating characteristics and standard mechanical construction for use under usual service conditions, such as those specified in NEMA MG 1, paragraph 14.02, "Usual Service Conditions," and without restriction to a particular application or type of application.
2. Standard operating characteristics or standard mechanical construction for use under unusual service conditions, such as those specified in NEMA MG 1, paragraph 14.03, "Unusual Service Conditions," or for a particular type of application, and that can be used in most general purpose applications.

General purpose electric motors (Subtype I) are constructed in NEMA T-frame sizes or IEC metric equivalent, starting at 143T.

GENERAL PURPOSE ELECTRIC MOTOR (SUBTYPE II). A motor incorporating the design elements of a general purpose electric motor (Subtype I) that is configured as one of the following:

1. A U-frame motor.
2. A Design C motor.
3. A close-coupled pump motor.
4. A footless motor.
5. A vertical, solid-shaft, normal-thrust motor (as tested in a horizontal configuration).
6. An 8-pole motor (900 rpm).
7. A polyphase motor with voltage of not more than 600 volts (other than 230 or 460 volts).

GREENHOUSE. A structure or a thermally isolated area of a building that maintains a specialized sunlit environment exclusively used for, and essential to, the cultivation, protection or maintenance of plants.

HEAT. The form of energy that is transferred by virtue of a temperature difference or a change in the state of a material.

HEAT TRAP. An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosiphoning of hot water during standby periods.

HEATED SLAB. Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

HIGH-SPEED DOOR. A nonswinging door used primarily to facilitate vehicular access or material transportation, with a minimum opening rate of 32 inches (813 mm) per second, a minimum closing rate of 24 inches (610 mm) per second and that includes an automatic-closing device.

HISTORIC BUILDING. Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
2. Designated as historic under an applicable state or local law.
3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.

HORSEPOWER (hp). Unit of power; work done at a rate equal to 745.7 watts, 550 foot lb. per second, or 33,000 foot lb. per minute.

HUMIDISTAT. A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

HVAC. Heating, ventilating and air conditioning.

HVAC SYSTEM. The equipment, distribution systems, and terminals that provide, either collectively or individually, the processes of heating, ventilating or air conditioning to a building or portion of a building.

INDIRECTLY CONDITIONED SPACE. See "Space."

INDOOR. Within the conditioned building envelope.

INFILTRATION. The uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building caused by pressure differences across these elements due to factors such as wind, inside and outside temperature differences (stack effect), and imbalance between supply and exhaust air systems.

INSULATION. Material mainly used to retard the flow of heat.

INTEGRATED PART LOAD VALUE (IPLV). A single-number figure of merit based on part-load EER, COP or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for equipment.

KILOWATT (kW). The basic unit of electric power, equal to KILOWATT (kW). The basic unit of electric power, equal to 1,000 watts.

LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a

nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LIGHTING SYSTEM. A group of luminaires circuited or controlled to perform a specific function.

LINER SYSTEM (Ls). A system that includes the following:

1. A continuous vapor barrier liner membrane that is installed below the purlins and that is uninterrupted by framing members.
2. An uncompressed, unfaced insulation resting on top of the liner membrane and located between the purlins.

For multilayer installations, the last rated *R*-value of insulation is for unfaced insulation draped over purlins and then compressed when the metal roof panels are attached.

LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the Building Official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

LOW-SLOPED ROOF. A roof having a slope less than 2 units vertical in 12 units horizontal.

LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMER. A transformer that is air-cooled, does not use oil as a coolant, has an input voltage less than or equal to 600 volts and is rated for operation at a frequency of 60 hertz.

LOW-VOLTAGE LIGHTING. Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

MANUAL. Capable of being operated by personal intervention (see “Automatic”).

MANUFACTURER. The company engaged in the original production and assembly of products or equipment or a company that purchases such products and equipment manufactured in accordance with company specifications.

MECHANICAL CLOSET. For the purposes of this Code, a closet used as an air plenum that contains the blower unit or air handler of a central air-conditioning or heating unit.

NAMEPLATE HORSEPOWER. The nominal motor horsepower rating stamped on the motor nameplate.

NONSTANDARD PART LOAD VALUE (NPLV). A single-number part-load efficiency figure of merit calculated and referenced to conditions other than IPLV conditions, for units that are not designed to operate at AHRI standard rating conditions.

OCCUPANCY. The purpose for which a building, or part thereof, is used or intended to be used. For the purposes of determining changes of occupancy for this Code, the occu-

pancy shall be considered the major occupancy group designations established by Chapter 5 of the *EPCOT Building Code*.

OCCUPANT SENSOR CONTROL. An automatic control device or system that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

ON-SITE RENEWABLE ENERGY. Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth. The energy system providing on-site renewable energy shall be located on the project site.

OPAQUE DOOR. A door that is not less than 50-percent opaque in surface area.

OUTDOOR. The environment exterior to the building structure.

OUTDOOR (OUTSIDE) AIR. Air that is outside the building envelope or is taken from outside the building that has not been previously circulated through the building.

OUTSIDE. The environment exterior to the conditioned space of the building and may include attics, garages, crawl-spaces, etc., but not return air plenums.

PLENUM. A compartment or chamber to which one or more ducts are connected, that forms a part of the air distribution system, and that is not used for occupancy or storage. A plenum often is formed in part or in total by portions of the building.

POSITIVE INDOOR PRESSURE. A positive pressure condition within a conditioned space caused by bringing in more outside air than the amount of air that is exhausted and/or lost through air leakage.

POWERED ROOF/WALL VENTILATORS. A fan consisting of a centrifugal or axial impeller with an integral driver in a weather-resistant housing and with a base designed to fit, usually by means of a curb, over a wall or roof opening.

PRESSURE ENVELOPE. The primary air barrier of a building; that part of the envelope that provides the greatest resistance to airflow to or from the building.

PRESSURE-SENSITIVE TAPE. Tape used for sealing duct system components and air barriers, which adheres when pressure is applied and is not heat activated.

PROPOSED DESIGN. A description or computer representation of the proposed building used to estimate annual energy use for determining compliance based on total building performance or design energy cost.

RADIANT HEATING SYSTEM. A heating system that transfers heat to objects and surfaces within a conditioned space, primarily by infrared radiation.

READILY ACCESSIBLE. Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see “Accessible”). In public facilities, accessibility may be limited to certified personnel through locking covers or by placing equipment in locked rooms.

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REFRIGERANT DEW POINT. The refrigerant vapor saturation temperature at a specified pressure.

REFRIGERATED WAREHOUSE COOLER. An enclosed storage space capable of being refrigerated to temperatures above 32°F (0°C), that can be walked into and has a total chilled storage area of not less than 3,000 square feet (279 m²).

REFRIGERATED WAREHOUSE FREEZER. An enclosed storage space capable of being refrigerated to temperatures at or below 32°F (0°C), that can be walked into and has a total chilled storage area of not less than 3,000 square feet (279 m²).

REFRIGERATION SYSTEM, LOW TEMPERATURE. Systems for maintaining food product in a frozen state in refrigeration applications.

REFRIGERATION SYSTEM, MEDIUM TEMPERATURE. Systems for maintaining food product above freezing in refrigeration applications.

REGISTERED DESIGN PROFESSIONAL. An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed. This includes any registered design professional so long as they are practicing within the scope of their license, which includes those licensed under Chapters 471 and 481, *Florida Statutes*.

RENOVATED BUILDING. A residential or nonresidential building undergoing alteration that varies or changes insulation, HVAC systems, water heating systems or exterior envelope conditions, provided the estimated cost of renovation exceeds 30 percent of the assessed value of the structure.

REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

REPLACEMENT. The installation of part or all of an existing mechanical or electrical system in an existing building.

REROOFING. The process of recovering or replacing an existing roof covering. See “Roof recover” and “Roof replacement.”

RESIDENTIAL BUILDING. For the purpose of this Code, includes R-3 buildings, as well as R-2 and R-4 buildings three stories or less in height above grade plane.

RETROFIT. Modification of existing equipment or systems to incorporate improved performance of operation.

ROOF. The upper portion of the building envelope, including opaque areas and fenestration, that is horizontal or tilted at an angle of less than 60° from horizontal. For the purposes of determining building envelope requirements, the classifications are defined as follows:

1. Attic and other roofs: all other roofs, including roofs with insulation entirely below (inside of) the roof structure (i.e., attics, cathedral ceilings, and single-rafter ceilings), roofs with insulation both above and below the roof structure, and roofs without insulation but excluding metal building roofs.

2. Metal building roof: a roof that is constructed with (a) a metal, structural, weathering surface, (b) has no ventilated cavity, and (c) has the insulation entirely below deck (i.e., does not include composite concrete and metal deck construction nor a roof framing system that is separated from the superstructure by a wood substrate) and whose structure consists of one or more of the following configurations: (1) metal roofing in direct contact with the steel framing members or (2) insulation between the metal roofing and the steel framing members or (3) insulated metal roofing panels installed as described in (1) or (2).
3. Roof with insulation entirely above deck: a roof with all insulation (1) installed above (outside of) the roof structure and (2) continuous (i.e., uninterrupted by framing members).
4. Single-rafter roof: a subcategory of attic roofs where the roof above and the ceiling below are both attached to the same wood rafter and where insulation is located in the space between these wood rafters.

ROOF ASSEMBLY. A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof covering, underlayment, roof deck, insulation, vapor retarder and interior finish.

ROOF RECOVER. The process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

ROOF REPAIR. Reconstruction or renewal of any part of an existing roof for the purpose of its maintenance.

ROOF REPLACEMENT. The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

ROOFTOP MONITOR. A raised section of a roof containing vertical fenestration along one or more sides.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$) [$(\text{m}^2 \cdot \text{K})/\text{W}$].

SATURATED CONDENSING TEMPERATURE. The saturation temperature corresponding to the measured refrigerant pressure at the condenser inlet for single component and azeotropic refrigerants, and the arithmetic average of the dew point and bubble point temperatures corresponding to the refrigerant pressure at the condenser entrance for zeotropic refrigerants.

SCREW LAMP HOLDERS. A lamp base that requires a screw-in-type lamp, such as a compact-fluorescent, incandescent or tungsten-halogen bulb.

SERVICE WATER HEATING. Supply of hot water for purposes other than comfort heating.

SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such

rooms and spaces that are also part of a dwelling unit are not sleeping units.

SMALL DUCT, HIGH-VELOCITY SYSTEM. A heating and cooling product that contains a blower and indoor coil combination that meets the following:

- 1) is designed for, and produces, at least 1.2 inches of external static pressure when operated at the certified air volume rate of 220–350 cfm per rated ton of cooling; and
- 2) when applied in the field, uses high-velocity room outlets generally greater than 1,000 fpm that have less than 6.0 square inches of free area.

SMALL ELECTRIC MOTOR. A general purpose, alternating current, single speed induction motor.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation which is then reradiated, conducted or convected into the space. (See “Fenestration area.”)

SPACE. An enclosed space within a building. The classifications of spaces are as follows for the purpose of determining building envelope requirements.

1. Conditioned space: a cooled space, heated space or indirectly conditioned space or unvented attic assembly defined as follows:
 - a. Cooled space: an enclosed space within a building that is cooled by a cooling system whose sensible output capacity exceeds 5 Btu/h · ft² of floor area.
 - b. Heated space: an enclosed space within a building that is heated by a heating system whose output capacity relative to the floor area is greater than or equal to 5 Btu/h · ft².
 - c. Indirectly conditioned space: an enclosed space within a building that is not a heated space or a cooled space, which is heated or cooled indirectly by being connected to adjacent space(s) provided (a) the product of the *U*-factor(s) and surface area(s) of the space adjacent to connected space(s) exceeds the combined sum of the product of the *U*-factor(s) and surface area(s) of the space adjoining the outdoors, unconditioned spaces, and to or from semiheated spaces (e.g., corridors) or (b) that air from heated or cooled spaces is intentionally transferred (naturally or mechanically) into the space at a rate exceeding 3 air changes per hour (ACH) (e.g., atria).
 - d. Unvented attic assembly: as defined in Subsection 705.6 of the *EPCOT Building Code*. These spaces shall not require supply or return outlets.
2. Semiheated space: an enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h · ft² of floor area but is not a conditioned space.
3. Unconditioned space: an enclosed space within a building that is not a conditioned space or a semiheated space. Crawl spaces, attics and parking garages with

natural or mechanical ventilation are not considered enclosed spaces.

STANDARD REFERENCE DESIGN. A version of the proposed design that meets the minimum requirements of this Code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

STOREFRONT. A nonresidential system of doors and windows mulled as a composite fenestration structure that has been designed to resist heavy use. Storefront systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings.

STRUCTURE. That which is built or constructed.

SUNROOM. For the purposes of this Code, the term “sunroom” as used herein shall be as follows and shall include conservatories, sunspaces, solariums and porch or patio covers or enclosures.

1. A room with roof panels that includes sloped glazing that is a one-story structure added to an existing dwelling with an open or glazed area in excess of 40 percent of the gross area of the sunroom structure’s exterior walls and roof.
2. A one-story structure added to a dwelling with structural roof panels without sloped glazing. The sunroom walls may have any configuration, provided the open area of the longer wall and one additional wall is equal to at least 65 percent of the area below 6 feet 8 inches of each wall, measured from the floor.

SYSTEM. A combination of equipment and auxiliary devices (e.g., controls, accessories, interconnecting means and terminal elements) by which energy is transformed so it performs a specific function such as HVAC, service water heating or lighting.

TERMINAL. A device by which energy from a system is finally delivered, e.g., registers, diffusers, lighting fixtures, faucets, etc.

THERMAL ENVELOPE. The primary insulation layer of a building; that part of the envelope that provides the greatest resistance to heat flow to or from the building.

THERMOSTAT. An automatic control device used to maintain temperature at a fixed or adjustable set point.

TIME SWITCH CONTROL. An automatic control device or system that controls lighting or other loads, including switching off, based on time schedules.

U-FACTOR (THERMAL TRANSMITTANCE). The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h · ft² · °F) [W/(m² · K)].

UNCONDITIONED SPACE. See “Space.”

VARIABLE REFRIGERANT FLOW MULTI-SPLIT AIR CONDITIONER. A Unit of commercial package air-conditioning and heating equipment that is configured as a split system air conditioner incorporating a single refrigerant

DEFINITIONS

circuit, with one or more outdoor units, at least one variable-speed compressor or an alternate compressor combination for varying the capacity of the system by three or more steps, and multiple indoor fan coil units, each of which is individually metered and individually controlled by an integral control device and common communications network and which can operate independently in response to multiple indoor thermostats. Variable refrigerant flow implies three or more steps of capacity control on common, interconnecting piping.

VARIABLE REFRIGERANT FLOW SYSTEM. An engineered direct-expansion (DX) refrigerant system that incorporates a common condensing unit, at least one variable-capacity compressor, a distributed refrigerant piping network to multiple indoor fan heating and cooling units each capable of individual zone temperature control, through integral zone temperature control devices and a common communications network. Variable refrigerant flow utilizes three or more steps of control on common interconnecting piping.

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

VENTILATION AIR. That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

VISIBLE TRANSMITTANCE [VT]. The ratio of visible light entering the space through the fenestration product assembly to the incident visible light. Visible transmittance includes the effects of glazing material and frame and is expressed as a number between 0 and 1.

WALK-IN COOLER. An enclosed storage space capable of being refrigerated to temperatures above 32°F (0°C) and less than 55°F (12.8°C) that can be walked into, has a ceiling height of not less than 7 feet (2134 mm) and has a total chilled storage area of less than 3,000 square feet (279 m²).

WALK-IN FREEZER. An enclosed storage space capable of being refrigerated to temperatures at or below 32°F (0°C) that can be walked into, has a ceiling height of not less than 7 feet (2134 mm) and has a total chilled storage area of less than 3,000 square feet (279 m²).

WALL, ABOVE-GRADE. A wall associated with the building thermal envelope that is more than 15 percent above grade and is on the exterior of the building or any wall that is associated with the building thermal envelope that is not on the exterior of the building.

WALL, BELOW-GRADE. A wall associated with the basement or first story of the building that is part of the building thermal envelope, is not less than 85 percent below grade and is on the exterior of the building.

WATER HEATER. Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system.

ZONE. A space or group of spaces within a building with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.

CHAPTER 3 [CE]

GENERAL REQUIREMENTS

SECTION C301 CLIMATE ZONES

C301.1 General. Table C301.1 shall be used in determining the applicable requirements from Chapter 4. Locations are assigned a climate zone based on Subsection C301.3.

Figure C301.1 Climate Zone. Reserved.

C301.2 Warm humid counties. Warm humid counties are identified in Table C301.1 by an asterisk.

C301.3 International climate zones. The climate zone for any location outside the United States shall be determined by applying Table C301.3(1) and then Table C301.3(2).

C301.4 Tropical climate zone. The tropical climate zone shall be defined as:

1. Hawaii, Puerto Rico, Guam, American Samoa, U.S. Virgin Islands, Commonwealth of Northern Mariana Islands; and
2. Islands in the area between the Tropic of Cancer and the Tropic of Capricorn.

SECTION C302 DESIGN CONDITIONS

C302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

SECTION C303 MATERIALS, SYSTEMS AND EQUIPMENT

C303.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this Code.

C303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be listed on the certification. For insulated siding, the *R*-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

C303.1.1.1 Blown or sprayed roof/ceiling insulation.

The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m²) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be listed on certification provided by the insulation installer.

C303.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.

TABLE C301.1
CLIMATE ZONES, MOISTURE REGIMES, AND WARM-HUMID DESIGNATIONS BY COUNTY

Key: A – Moist
Asterisk (*) indicates a warm-humid location.

FLORIDA	2A DeSoto*	2A Highlands*	2A Marion*	2A Santa Rosa*
2A Alachua*	2A Dixie*	2A Hillsborough*	2A Martin*	2A Sarasota*
2A Baker*	2A Duval*	2A Holmes*	1A Miami-Dade*	2A Seminole*
2A Bay*	2A Escambia*	2A Indian River*	1A Monroe*	2A St. Johns*
2A Bradford*	2A Flagler*	2A Jackson*	2A Nassau*	2A St. Lucie*
2A Brevard*	2A Franklin*	2A Jefferson*	2A Okaloosa*	2A Sumter*
1A Broward*	2A Gadsden*	2A Lafayette*	2A Okeechobee*	2A Suwannee*
2A Calhoun*	2A Gilchrist*	2A Lake*	2A Orange*	2A Taylor*
2A Charlotte*	2A Glades*	1A Lee*	2A Osceola*	2A Union*
2A Citrus*	2A Gulf*	2A Leon*	1A Palm Beach*	2A Volusia*
2A Clay*	2A Hamilton*	2A Levy*	2A Pasco*	2A Wakulla*
1A Collier*	2A Hardee*	2A Liberty*	2A Pinellas*	2A Walton*
2A Columbia*	1A Hendry*	2A Madison*	2A Polk*	2A Washington*
	2A Hernando*	2A Manatee*	2A Putnam*	

GENERAL REQUIREMENTS

TABLE C301.3(1)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

MAJOR CLIMATE TYPE DEFINITIONS	
Marine (C) Definition—Locations meeting all four criteria:	
<ol style="list-style-type: none"> 1. Mean temperature of coldest month between -3°C (27°F) and 18°C (65°F). 2. Warmest month mean < 22°C (72°F). 3. At least four months with mean temperatures over 10°C (50°F). 4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere. 	
Dry (B) Definition—Locations meeting the following criteria:	
Not marine and $P_{in} < 0.44 \times (TF - 19.5)$ [$P_{cm} < 2.0 \times (TC + 7)$ in SI units] where: P_{in} = Annual precipitation in inches (cm) T = Annual mean temperature in °F (°C)	
Moist (A) Definition—Locations that are not marine and not dry.	
Warm-humid Definition—Moist (A) locations where either of the following wet-bulb temperature conditions shall occur during the warmest six consecutive months of the year:	
<ol style="list-style-type: none"> 1. 67°F (19.4°C) or higher for 3,000 or more hours; or 2. 73°F (22.8°C) or higher for 1,500 or more hours. 	

For SI: °C = [(°F) - 32]/1.8, 1 inch = 2.54 cm.

TABLE C301.3(2)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
1	9000 < CDD50°F	5000 < CDD10°C
2	6300 < CDD50°F ≤ 9000	3500 < CDD10°C ≤ 5000
3A and 3B	4500 < CDD50°F ≤ 6300 AND HDD65°F ≤ 5400	2500 < CDD10°C ≤ 3500 AND HDD18°C ≤ 3000
4A and 4B	CDD50°F ≤ 4500 AND HDD65°F ≤ 5400	CDD10°C ≤ 2500 AND HDD18°C ≤ 3000
3C	HDD65°F ≤ 3600	HDD18°C ≤ 2000
4C	3600 < HDD65°F ≤ 5400	2000 < HDD18°C ≤ 3000
5	5400 < HDD65°F ≤ 7200	3000 < HDD18°C ≤ 4000
6	7200 < HDD65°F ≤ 9000	4000 < HDD18°C ≤ 5000
7	9000 < HDD65°F ≤ 12600	5000 < HDD18°C ≤ 7000
8	12600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F) - 32]/1.8.

C303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

Exception: Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).

C303.1.4 Insulation product rating. The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (CFR Title 16, Part 460) in units of $\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$ at a mean temperature of 75°F (24°C).

C303.1.4.1 Insulated siding. The thermal resistance (*R*-value) of insulated siding shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer's instructions.

C303.2 Installation. Materials, systems and equipment shall be installed in accordance with the manufacturer's instructions and the *EPCOT Building Code*.

C303.2.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawl-space walls and the perimeter of slab-on-grade floors shall

have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend not less than 6 inches (153 mm) below grade.

C303.3 Maintenance information. Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

SECTION C304 MATERIALS TESTING AND THERMAL PROPERTIES

C304.1 Building material thermal properties, general.

C304.1.1 Commercial and residential high rise. *R*-values for building materials used to demonstrate code compliance with Chapter C4 shall be taken from ASHRAE 90.1 Normative Appendix A, from manufacturer's product literature or from other nationally recognized engineering sources. Assembly *U*-factor calculations shall follow the procedure(s) detailed in Subsection C304.3 or be tested in accordance with procedure(s) described in Subsection C304.2.

Concrete block *R*-values shall be calculated using the isothermal planes method or a two-dimensional calculation program, thermal conductivities from ASHRAE 90.1 Normative Appendix A and dimensions from ASTM C90. The parallel path calculation method is not acceptable.

Exception: *R*-values for building materials or thermal conductivities determined from testing in accordance with Subsection C304.2.

**TABLE C303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTORS**

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

**TABLE C303.1.3(2)
DEFAULT DOOR *U*-FACTORS**

DOOR TYPE	<i>U</i> -FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

**TABLE C303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT**

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

C304.2 Testing of building materials thermal properties.

C304.2.1 Single materials. If building material R -values or thermal conductivities are determined by testing, one of the following test procedures shall be used:

- a. ASTM C177
- b. ASTM C236
- c. ASTM C518

For concrete, the oven-dried conductivity shall be multiplied by 1.2 to reflect the moisture content as typically installed.

C304.2.2 Assembly U -factors. If assembly U -factors are determined by testing, ASTM C1363 shall be used. Product samples tested shall be production line material or representative of material as purchased by the consumer or contractor. If the assembly is too large to be tested at one time in its entirety, then either a representative portion shall be tested or different portions shall be tested separately and a weighted average determined. To be representative, the portion tested shall include edges of panels, joints with other panels, typical framing percentages and thermal bridges.

C304.3 Calculation procedures and assumptions. The following procedures and assumptions shall be used for all Chapter 4 code calculations. R -values for air films, insulation and building materials shall be taken from Subsection C304.3.1 or C304.3.2, respectively. In addition, the appropriate assumptions listed, including framing factors, shall be used.

C304.3.1 Air films. Prescribed R -values for air films shall be as follows:

R-Value	Condition
0.17	All exterior surfaces
0.46	All semi-exterior surfaces
0.61	Interior horizontal surfaces, heat flow up
0.92	Interior horizontal surfaces, heat flow down
0.68	Interior vertical surfaces

C304.3.1.1 Exterior surfaces are areas exposed to the wind.

C304.3.1.2 Semi-exterior surfaces are protected surfaces that face attics, crawl spaces and parking garages with natural or mechanical ventilation.

C304.3.1.3 Interior surfaces are surfaces within enclosed spaces.

C304.3.1.4 The R -value for cavity airspaces shall be taken from ASHRAE 90.1 Normative Appendix A. No credit shall be given for airspaces in cavities that contain any insulation or less than 0.5 inch (12.7 mm). The values for 3.5 inch-cavities (84 mm) shall be used for cavities of that width and greater.

C304.3.2 Assembly U -factor, C -factor and F -factor calculation.

C304.3.2.1 Pre-calculated assembly U -factors, C -factors, F -factors or heat capacities. The U -factors, C -factors, F -factors, and heat capacities for typical construction assemblies from ASHRAE 90.1 Normative Appendix A shall be used for all calculations unless otherwise allowed by applicant-determined assembly U -factors, C -factors, F -factors or heat capacities. Interpolation between values for rated R -values of insulation, including insulated sheathing is allowed; extrapolation beyond values in the ASHRAE 90.1 Normative Appendix A tables is not.

C304.3.2.2 Applicant-determined assembly U -factors, C -factors, F -factors or heat capacities. If the building official determines that the proposed construction assembly is not adequately represented in the appropriate table of ASHRAE 90.1 Normative Appendix A, the applicant shall determine appropriate values for the assembly using the assumptions in ASHRAE 90.1 Normative Appendix A. An assembly is deemed to be adequately represented if:

- a. the interior structure, hereafter referred to as the base assembly, for the class of construction is the same as described in Normative Appendix A, *and*
- b. changes in exterior or interior surface building materials added to the base assembly do not increase or decrease the R -value by more than 2 from that indicated in the descriptions in ASHRAE 90.1 Normative Appendix A.

Insulation, including insulated sheathing, is not considered a building material.

CHAPTER 4 [CE]

COMMERCIAL ENERGY EFFICIENCY

SECTION C401 GENERAL

C401.1 Scope. The provisions in this Chapter are applicable to commercial buildings and their building sites.

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1, excluding section 9.4.1.1(g) of the standard.
2. The requirements of Sections C402 through C405. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Subsection C406.1.1.
3. The requirements of Subsections C402.5, C403.2, C404, C405.2, C405.3, C405.5, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

C401.2.1 Application to replacement fenestration products. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and *SHGC* in Table C402.4.

Exception: An area-weighted average of the *U*-factor of replacement fenestration products being installed in the building for each fenestration product category listed in Table C402.4 shall be permitted to satisfy the *U*-factor requirements for each fenestration product category listed in Table C402.4. Individual fenestration products from different product categories listed in Table C402.4 shall not be combined in calculating the area-weighted average *U*-factor.

SECTION C402 BUILDING ENVELOPE REQUIREMENTS

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis, in accordance with the compliance path described in Item 2 of Subsection C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Subsection C402.2 and the thermal requirements of either the *R*-value-based method of Subsection C402.1.3; the *U*-, *C*- and *F*-factor-based method of Subsection C402.1.4; or the component performance alternative of Subsection C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Subsection C402.3.
3. Fenestration in building envelope assemblies shall comply with Subsection C402.4.
4. Air leakage of building envelope assemblies shall comply with Subsection C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Subsection C402.4, the building and building thermal envelope shall comply with Subsection C401.2, Item 1 or Subsection C401.2, Item 3.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Subsection C403.2.15 or C403.2.16.

C402.1.1 Low-energy buildings. The following low-energy buildings, or portions thereof separated from the remainder of the building by building thermal envelope assemblies complying with this Section, shall be exempt from the building thermal envelope provisions of Section C402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h · ft² (10.7 W/m²) or 1.0 watt per square foot (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Greenhouses.

C402.1.2 Equipment buildings. Buildings that comply with the following shall be exempt from the building thermal envelope provisions of this Code:

1. Are separate buildings with floor area not more than 500 square feet (50 m²).
2. Are intended to house electronic equipment with installed equipment power totaling not less than 7 watts per square foot (75 W/m²) and not intended for human occupancy.
3. Have a heating system capacity not greater than (17,000 Btu/hr) (5 kW) and a heating thermostat set point that is restricted to not more than 50°F (10°C).
4. Have an average wall and roof *U*-factor less than 0.200 in Climate Zones 1 through 5 and less than 0.120 in Climate Zones 6 through 8.
5. Comply with the roof solar reflectance and thermal emittance provisions for Climate Zone 1.

C402.1.3 Insulation component *R*-value-based method.

Building thermal envelope opaque assemblies shall meet the requirements of Subsections C402.2 and C402.4 based on the climate zone specified in Chapter 3. For opaque portions of the building thermal envelope intended to comply on an insulation component *R*-value basis, the *R*-values for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in Table C402.1.3, based on the climate zone specified in Chapter 3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *R*-values from the “Group R” column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *R*-values from the “All other” column of Table C402.1.3. The

thermal resistance or *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque non-swinging doors shall comply with Table C402.1.3.

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*- or *F*-factor basis shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the *U*-, *C*- or *F*-factor from the “Group R” column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the *U*-, *C*- or *F*-factor from the “All other” column of Table C402.1.4. The *C*-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque swinging doors shall comply with Table C402.1.4 and opaque non-swinging doors shall comply with Table C402.1.3.

C402.1.4.1 Thermal resistance of cold-formed steel walls. *U*-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1:

$$U = 1/[R_s + (ER)] \quad (\text{Equation 4-1})$$

where:

R_s = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the cavity insulation and steel studs.

ER = The effective *R*-value of the cavity insulation with steel studs.

**TABLE C402.1.4.1
EFFECTIVE R-VALUES FOR STEEL STUD WALL ASSEMBLIES**

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY R-VALUE (insulation)	CORRECTION FACTOR (F _c)	EFFECTIVE R-VALUE (ER) (Cavity R-Value + F _c)
31/2	16	13	0.46	5.98
		15	0.43	6.45
31/2	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be permitted in lieu of compli-

ance with the *U*-, *F*- and *C*-factors in Tables C402.1.4 and C402.4 and the maximum allowable fenestration areas in Subsection C402.4.1.

$$A + B + C + D + E \leq \text{Zero} \quad (\text{Equation 4-2})$$

where:

A = Sum of the (UA Dif) values for each distinct assembly type of the building thermal envelope, other than slabs on grade and below-grade walls.

UA Dif = UA Proposed - UA Table.

UA Proposed = Proposed *U*-value · Area.

UA Table = (*U*-factor from Table C402.1.4 or Table C402.4) · Area.

B = Sum of the (FL Dif) values for each distinct slab-on-grade perimeter condition of the building thermal envelope.

FL Dif = FL Proposed - FL Table.

FL Proposed = Proposed *F*-value · Perimeter length.

FL Table = (*F*-factor specified in Table C402.1.4) · Perimeter length.

C = Sum of the (CA Dif) values for each distinct below-grade wall assembly type of the building thermal envelope.

CA Dif = CA Proposed - CA Table.

CA Proposed = Proposed *C*-value · Area.

CA Table = (Maximum allowable *C*-factor specified in Table C402.1.4) · Area.

Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Subsection C402.4.1, the value of *D* (Excess Vertical Glazing Value) shall be zero. Otherwise:

D = (*DA* · *UV*) - (*DA* · *U* Wall), but not less than zero.

DA = (Proposed Vertical Glazing Area) - (Vertical Glazing Area allowed by Subsection C402.4.1).

U Wall = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.

U Wall = Area-weighted average *U*-value of all above-grade wall assemblies.

UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.

UV = *UAV*/total vertical glazing area.

Where the proposed skylight area is less than or equal to the skylight area allowed by Subsection C402.4.1, the value of *E* (Excess Skylight Value) shall be zero. Otherwise:

E = (*EA* · *US*) - (*EA* · *U* Roof), but not less than zero.

EA = (Proposed Skylight Area) - (Allowable Skylight Area as specified in Subsection C402.4.1).

U Roof = Area-weighted average *U*-value of all roof assemblies.

UAS = Sum of the (UA Proposed) values for each skylight assembly.

US = *UAS*/total skylight area.

**TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD^a**

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal building ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20
Walls, below grade																
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-10ci	R-10ci	R-12.5ci
Floors																
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-15ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30 ^f	R-30 ^f	R-30 ^f
Slab-on-grade floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs ^f	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below	R-20 for 24" below	R-20 for 24" below	R-20 for 24" below
Opaque doors																
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h² °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or
2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

f. Steel floor joist systems shall be insulated to R-38.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4		5		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade																
Mass	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.090	U-0.090	U-0.090	U-0.080	U-0.071	U-0.071	U-0.071	U-0.061	U-0.061	U-0.061
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.057	U-0.057	U-0.064	U-0.052	U-0.045	U-0.045
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036
Walls, below grade																
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092	C-0.092	C-0.092
Floors																
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.057	U-0.055	U-0.051	U-0.055	U-0.051	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors																
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40	F-0.40	F-0.40	F-0.40
Heated slabs ^f	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly U-factors, C-factors, and F-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly U-factors based on designs tested in accordance with ASTM C1363 shall be permitted. The R-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.

c. Where heated slabs are below grade, below-grade walls shall comply with the F-factor requirements for heated slabs.

d. "Mass floors" shall include floors weighing not less than:

1. 35 pounds per square foot of floor surface area; or
2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.

e. These C-, F- and U-factors are based on assemblies that are not required to contain insulation.

f. Evidence of compliance with the F-factors indicated in the table for heated slabs shall be demonstrated by the application of the unheated slab F-factors and R-values derived from ASHRAE 90.1 Appendix A.

C402.2 Specific building thermal envelope insulation requirements (Prescriptive). Insulation in building thermal envelope opaque assemblies shall comply with Subsections C402.2.1 through C402.2.6 and Table C402.1.3.

C402.2.1 Multiple layers of continuous insulation board. Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with Subsection C303.2. Where the continuous insulation board manufacturer's instructions do not address installation of two or more layers, the edge joints between each layer of continuous insulation boards shall be staggered.

C402.2.2 Roof assembly. The minimum thermal resistance (R -value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R -5, whichever is less.

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted U -factor is equivalent to the same assembly with the R -value specified in Table C402.1.3.
2. Where tapered insulation is used with insulation entirely above deck, the R -value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered insulation shall comply with the R -value specified in Table C402.1.3.
3. Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

C402.2.3 Thermal resistance of above-grade walls. The minimum thermal resistance (R -value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The R -value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3.

"Mass walls" shall include walls:

1. Weighing not less than 35 psf (170 kg/m²) of wall surface area.
2. Weighing not less than 25 psf (120 kg/m²) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m³).
3. Having a heat capacity exceeding 7 Btu/ft² · °F (144 kJ/m² · K).
4. Having a heat capacity exceeding 5 Btu/ft² · °F (103 kJ/m² · K), where the material weight is not more than 120 pcf (1900 kg/m³).

C402.2.4 Floors. The thermal properties (component R -values or assembly U -, C - or F -factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly. Floor framing cavity insulation or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.

Exceptions:

1. The floor framing cavity insulation or structural slab insulation shall be permitted to be in contact with the top side of sheathing or continuous insulation installed on the bottom side of floor assemblies where combined with insulation that meets or exceeds the minimum R -value in Table C402.1.3 for "Metal framed" or "Wood framed and other" values for "Walls, Above Grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.
2. Insulation applied to the underside of concrete floor slabs shall be permitted an airspace of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the building thermal envelope.

C402.2.5 Slabs-on-grade perimeter insulation. Where the slab on grade is in contact with the ground, the minimum thermal resistance (R -value) of the insulation around the perimeter of unheated or heated slab-on-grade floors designed in accordance with the R -value method of Subsection C402.1.3 shall be as specified in Table C402.1.3. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil.

Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

C402.2.6 Insulation of radiant heating systems. Radiant heating system panels, and their associated components that are installed in interior or exterior assemblies shall be insulated with a minimum of R -3.5 (0.62 m²/K · W) on all surfaces not facing the space being heated. Radiant heating system panels that are installed in the building thermal envelope shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the R -value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Subsection C402.1.4.

Exception: Heated slabs on grade insulated in accordance with Subsection C402.2.5.

C402.3 Roof solar reflectance and thermal emittance.

Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that include or are covered by the following:
 - 1.1. Photovoltaic systems or components.
 - 1.2. Solar air or water-heating systems or components.
 - 1.3. Roof gardens or landscaped roofs.
 - 1.4. Above-roof decks or walkways.
 - 1.5. Skylights.
 - 1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot [74 kg/m²] or 23 psf [117 kg/m²] pavers.

4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this Section.

C402.3.1 Aged roof solar reflectance. Where an aged solar reflectance required by Subsection C402.3 is not available, it shall be determined in accordance with Equation 4-3.

$$R_{aged} = [0.2 + 0.7(R_{initial} - 0.2)] \quad \text{(Equation 4-3)}$$

where:

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-1 Standard.

C402.4 Fenestration (Prescriptive). Fenestration shall comply with Subsections C402.4 through C402.4.4 and Table C402.4. Daylight responsive controls shall comply with this Section and Subsection C405.2.3.1.

C402.4.1 Maximum area. The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not be greater than 30 percent of the gross above-grade wall area. The skylight area shall not be greater than 3 percent of the gross roof area.

TABLE C402.3
MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS^a

Three-year aged solar reflectance ^b of 0.55 and 3-year aged thermal emittance ^c of 0.75
Three-year-aged solar reflectance index ^d of 64

- a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Subsection C402.3.1 and a 3-year-aged thermal emittance of 0.90.
- b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-1 Standard.
- c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRC-1 Standard.
- d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h · ft² · °F (12W/m² · K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance.

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
Orientation ^a	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.40	0.53
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.48	0.58
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.64	0.64
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement, PF = Projection factor.

- a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

C402.4.1.1 Increased vertical fenestration area with daylight responsive controls. In Climate Zones 1 through 6, not more than 40 percent of the gross above-grade wall area shall be permitted to be vertical fenestration, provided all of the following requirements are met:

1. In buildings not greater than two stories above grade, not less than 50 percent of the net floor area is within a daylight zone.
2. In buildings three or more stories above grade, not less than 25 percent of the net floor area is within a daylight zone.
3. Daylight responsive controls complying with Subsection C405.2.3.1 are installed in daylight zones.
4. Visible transmittance (VT) of vertical fenestration is not less than 1.1 times solar heat gain coefficient (SHGC).

Exception: Fenestration that is outside the scope of NFRC 200 is not required to comply with Item 4.

C402.4.1.2 Increased skylight area with daylight responsive controls. The skylight area shall be permitted to be not more than 5 percent of the roof area provided daylight responsive controls complying with Subsection C405.2.3.1 are installed in daylight zones under skylights.

C402.4.2 Minimum skylight fenestration area. In an enclosed space greater than 2,500 square feet (232 m²) in floor area, directly under a roof with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, convention center, automotive service area, space where manufacturing occurs, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation depot or workshop, the total daylight zone under skylights shall be not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to daylight zone under skylights of not less than 3 percent where all skylights have a VT of at least 0.40 as determined in accordance with Subsection C303.1.3.
2. A minimum skylight effective aperture of at least 1 percent, determined in accordance with Equation 4-4.

Skylight Effective Aperture =

$$\frac{0.85 \cdot \text{Skylight Area} \cdot \text{Skylight VT} \cdot \text{WF}}{\text{Daylight zone under skylight}} \quad (\text{Equation 4-4})$$

where:

- Skylight area = Total fenestration area of skylights.
- Skylight VT = Area weighted average visible transmittance of skylights.
- WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light

well depth is 2 feet (610 mm) or greater.

Light well depth = Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

Exception: Skylights above daylight zones of enclosed spaces are not required in:

1. Buildings in Climate Zones 6 through 8.
2. Spaces where the designed general lighting power densities are less than 0.5 W/ft² (5.4 W/m²).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on at least half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 a.m. and 4 p.m.
4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area.
5. Spaces where the total area minus the area of daylight zones adjacent to vertical fenestration is less than 2,500 square feet (232 m²), and where the lighting is controlled according to Subsection C405.2.3.

C402.4.2.1 Lighting controls in daylight zones under skylights. Daylight responsive controls complying with Subsection C405.2.3.1 shall be provided to control all electric lights within daylight zones under skylights.

C402.4.2.2 Haze factor. Skylights in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of skylight and light well.

C402.4.3 Maximum U-factor and SHGC. The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Equation 4-5.

$$PF = A/B \quad (\text{Equation 4-5})$$

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the farthest continuous extremity of any overhang, eave or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave or permanently attached shading device.

Where different windows or glass doors have different PF values, they shall each be evaluated separately.

C402.4.3.1 Increased skylight SHGC. In Climate Zones 1 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above daylight zones provided with daylight responsive controls.

C402.4.3.2 Increased skylight *U*-factor. Where skylights are installed above daylight zones provided with daylight responsive controls, a maximum *U*-factor of 0.9 shall be permitted in Climate Zones 1 through 3 and a maximum *U*-factor of 0.75 shall be permitted in Climate Zones 4 through 8.

C402.4.3.3 Dynamic glazing. Where dynamic glazing is intended to satisfy the SHGC and VT requirements of Table C402.4, the ratio of the higher to lower labeled SHGC shall be greater than or equal to 2.4, and the dynamic glazing shall be automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

Exception: Dynamic glazing is not required to comply with this Section where both the lower and higher labeled SHGC already comply with the requirements of Table C402.4.

C402.4.3.4 Area-weighted *U*-factor. An area-weighted average shall be permitted to satisfy the *U*-factor requirements for each fenestration product category listed in Table C402.4. Individual fenestration products from different fenestration product categories listed in Table C402.4 shall not be combined in calculating area-weighted average *U*-factor.

C402.4.4 Doors. Opaque doors shall comply with the applicable requirements for doors as specified in Tables C402.1.3 and C402.1.4 and be considered part of the gross area of above-grade walls that are part of the building thermal envelope. Other doors shall comply with the provisions of Subsection C402.4.3 for vertical fenestration.

C402.5 Air leakage—thermal envelope (Mandatory). The thermal envelope of buildings shall comply with Subsections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the Building Official and deemed to comply with the provisions of this Section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (2.0 L/s · m²). Where compliance is based on such testing, the building shall also comply with Subsections C402.5.5, C402.5.6 and C402.5.7.

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Subsections C402.5.1.1 and C402.5.1.2.

Exception: Air barriers are not required in buildings located in Climate Zone 2B.

C402.5.1.1 Air barrier construction. The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.
2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Joints and seals associated with penetrations shall be sealed in the same manner or taped or covered with moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed and shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.
4. Recessed lighting fixtures shall comply with Subsection C402.5.8. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

C402.5.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall comply with Subsection C402.5.1.2.1 or C402.5.1.2.2.

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft² (0.02 L/s · m²) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this Section. Materials in Items 1 through 16 shall be deemed to comply with this Section, provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

1. Plywood with a thickness of not less than $\frac{3}{8}$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $\frac{3}{8}$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).

4. Foil-back polyisocyanurate insulation board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m³) having a thickness of not less than $\frac{1}{2}$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches (113 mm).
7. Exterior or interior gypsum board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
8. Cement board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
9. Built-up roofing membrane.
10. Modified bituminous roof membrane.
11. Fully adhered single-ply roof membrane.
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than $\frac{5}{8}$ inch (15.9 mm).
13. Cast-in-place and precast concrete.
14. Fully grouted concrete block masonry.
15. Sheet steel or aluminum.
16. Solid or hollow masonry constructed of clay or shale masonry units.

C402.5.1.2.2 Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft² (0.2 L/s · m²) under a pressure differential of 0.3 inch of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E2357, ASTM E1677 or ASTM E283 shall comply with this Section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided joints are sealed and the requirements of Subsection C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.
3. A Portland cement/sand parge, stucco or plaster not less than $\frac{1}{2}$ inch (12.7 mm) in thickness.

C402.5.2 Air leakage of fenestration. The air leakage of fenestration assemblies shall meet the provisions of Table C402.5.2. Testing shall be in accordance with the applicable reference test standard in Table C402.5.2 by an accredited, independent testing laboratory and labeled by the manufacturer.

Exceptions:

1. Field-fabricated fenestration assemblies that are sealed in accordance with Subsection C402.5.1.
2. Fenestration in buildings that comply with the testing alternative of Subsection C402.5 are not required to meet the air leakage requirements in Table C402.5.2.

C402.5.3 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion space conditioning fuel-burning appliances, the appliances and combustion air openings shall be located outside of the building thermal envelope or enclosed in a room isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table C402.1.3 or C402.1.4, where the walls, floors and ceilings shall meet the minimum of the below-grade wall *R*-value requirement. The door into the room shall be fully gasketed, and any water lines and ducts in the room insulated in accordance with Section C403. The combustion air duct shall be insulated, where it passes through conditioned space, to a minimum of *R*-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Fireplaces and stoves complying with the *EPCOT Mechanical Code* and the *EPCOT Building Code*.

**TABLE C402.5.2
MAXIMUM AIR LEAKAGE RATE
FOR FENESTRATION ASSEMBLIES**

FENESTRATION ASSEMBLY	MAXIMUM RATE (CFM/FT ²)	TEST PROCEDURE
Windows	0.20 ^a	AAMA/WDMA/ CSA101/I.S.2/A440 or NFRC 400
Sliding doors	0.20 ^a	
Swinging doors	0.20 ^a	
Skylights – with condensation weepage openings	0.30	
Skylights – all other	0.20 ^a	
Curtain walls	0.06	NFRC 400 or ASTM E283 at 1.57 psf (75 Pa)
Storefront glazing	0.06	
Commercial glazed swinging entrance doors	1.00	
Revolving doors	1.00	
Garage doors	0.40	ANSI/DASMA 105, NFRC 400, or ASTM E283 at 1.57 psf (75 Pa)
Rolling doors	1.00	
High-speed doors	1.30	

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093 m².

- a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).

C402.5.4 Doors and access openings to shafts, chutes, stairways and elevator lobbies. Doors and access openings from conditioned space to shafts, chutes stairways and elevator lobbies not within the scope of the fenestration assemblies covered by Subsection C402.5.2 shall be gasketed, weatherstripped or sealed.

Exceptions:

1. Door openings required to comply with the *EPCOT Building Code*.
2. Doors and door openings required to comply with UL 1784 by the *EPCOT Building Code*.

C402.5.5 Air intakes, exhaust openings, stairways and shafts. Stairway enclosures, elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be provided with dampers in accordance with Subsection C403.2.4.3.

C402.5.6 Loading dock weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.

C402.5.7 Vestibules. Building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors.

Exceptions: Vestibules are not required for the following:

1. Buildings in Climate Zones 1 and 2.
2. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.
3. Doors opening directly from a sleeping unit or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m²) in area.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
7. Doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Subsection C408.2.3.

C402.5.8 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be all of the following:

1. IC-rated.
2. Labeled as having an air leakage rate of not more 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential.
3. Sealed with a gasket or caulk between the housing and interior wall or ceiling covering.

C402.5.9 Building cavities.

C402.5.9.1 Vented dropped ceiling cavities. Where vented dropped ceiling cavities occur over conditioned spaces, the ceiling shall be considered to be both the upper thermal envelope and pressure envelope of the building and shall contain a continuous air barrier

between the conditioned space and the vented unconditioned space that is also sealed to the air barrier of the walls. See the definition of air barrier in Section C202.

C402.5.9.2 Unvented dropped ceiling cavities. Where unvented dropped ceiling cavities occur over conditioned spaces that do not have an air barrier between the conditioned and unconditioned space (such as T-bar ceilings), they shall be completely sealed from the exterior environment (at the roof plane) and adjacent spaces by a continuous air barrier that is also sealed to the air barrier of the walls. In that case, the roof assembly shall constitute both the upper thermal envelope and pressure envelope of the building.

C402.5.9.3 Separate tenancies. Unconditioned spaces above separate tenancies shall contain dividing partitions between the tenancies to form a continuous air barrier that is sealed at the ceiling and roof to prevent airflow between them.

C402.5.9.4 Air distribution system components. Building cavities designed to be air distribution system components shall be sealed according to the criteria for air ducts, plenums, etc., in Subsection C403.2.9.

SECTION C403 BUILDING MECHANICAL SYSTEMS

C403.1 General. Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Subsection C403.2 and shall comply with Subsections C403.3 and C403.4 based on the equipment and systems provided.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Subsection C403.2.15 or C403.2.16.

C403.2 Provisions applicable to all mechanical systems (Mandatory). Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Subsections C403.2.1 through C403.2.16.

C403.2.1 Calculation of heating and cooling loads.

Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183 or ACCA Manual N or by an approved equivalent computational procedure using the design parameters specified in Chapter 3. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook* by an approved equivalent computational procedure. Design loads shall be attached to the code compliance form submitted to the building department when the building is permitted or, in the event the mechanical permit is obtained at a later time, the sizing calculation shall be submitted with the application for the mechanical permit.

Exception: Where mechanical systems are designed by a registered engineer, the engineer has the option of submitting a signed and sealed summary sheet to the building department in lieu of the complete sizing cal-

ulation(s). Such summary sheet shall include the following (by zone):

1. Project name/owner
2. Project address
3. Area in square feet
4. Sizing method used
5. Outdoor dry bulb use
6. Indoor dry bulb
7. Outdoor wet bulb used
8. Grains water (difference)
9. Total sensible gain
10. Total latent gain
11. Relative humidity
12. Total cooling required with outside air
13. Total heating required with outside air

C403.2.2 Equipment sizing. The output capacity of heating and cooling equipment shall be not greater than the loads calculated in accordance with Subsection C403.2.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

Exceptions:

1. Required standby equipment and systems provided with controls and devices that allow such

systems or equipment to operate automatically only when the primary equipment is not operating.

2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that have the capability to sequence the operation of each unit based on load.

C403.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables C403.2.3(1), C403.2.3(2), C403.2.3(3), C403.2.3(4), C403.2.3(5), C403.2.3(6), C403.2.3(7), C403.2.3(8) and C403.2.3(9) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(10).

The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

**TABLE C403.2.3(1)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS**

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE ^a
				Before 1/1/2016	As of 1/1/2016	
Air conditioners, air cooled	< 65,000 Btu/h ^b	All	Split System	13.0 SEER	13.0 SEER	AHRI 210/240
			Single Package	13.0 SEER	14.0 SEER ^c	
Through-the-wall (air cooled)	≤ 30,000 Btu/h ^b	All	Split system	12.0 SEER	12.0 SEER	
			Single Package	12.0 SEER	12.0 SEER	
Small-duct high-velocity (air cooled)	< 65,000 Btu/h ^b	All	Split System	11.0 SEER	11.0 SEER	
Air conditioners, air cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.2 EER 11.4 IEER	11.2 EER 12.8 IEER	AHRI 340/360
		All other	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.6 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.4 IEER	
		All other	Split System and Single Package	10.8 EER 11.0 IEER	10.8 EER 12.2 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.0 EER 10.1 IEER	10.0 EER 11.6 IEER	
		All other	Split System and Single Package	9.8 EER 9.9 IEER	9.8 EER 11.4 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER 9.8 IEER	9.7 EER 11.2 IEER	
		All other	Split System and Single Package	9.5 EER 9.6 IEER	9.5 EER 11.0 IEER	

(continued)

TABLE C403.2.3(1)—continued
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUB-CATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE ^a
				Before 1/1/2016	As of 1/1/2016	
Air conditioners, water cooled	< 65,000 Btu/h ^b	All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 13.9 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 13.7 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.5 EER 12.5 IEER	12.5 EER 13.9 IEER	
		All other	Split System and Single Package	12.3 EER 12.5 IEER	12.3 EER 13.7 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.4 EER 12.6 IEER	12.4 EER 13.6 IEER	
		All other	Split System and Single Package	12.2 EER 12.4 IEER	12.2 EER 13.4 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.2 EER 12.4 IEER	12.2 EER 13.5 IEER	
		All other	Split System and Single Package	12.0 EER 12.2 IEER	12.0 EER 13.3 IEER	
Air conditioners, evaporatively cooled	< 65,000 Btu/h ^b	All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	12.0 EER 12.2 IEER	12.0 EER 12.2 IEER	
		All other	Split System and Single Package	11.8 EER 12.0 IEER	11.8 EER 12.0 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.9 EER 12.1 IEER	11.9 EER 12.1 IEER	
		All other	Split System and Single Package	11.7 EER 11.9 IEER	11.7 EER 11.9 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.7 EER 11.9 IEER	11.7 EER 11.9 IEER	
		All other	Split System and Single Package	11.5 EER 11.7 IEER	11.5 EER 11.7 IEER	
Condensing units, air cooled	≥ 135,000 Btu/h			10.5 EER 11.8 IEER	10.5 EER 11.8 IEER	AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h			13.5 EER 14.0 IEER	13.5 EER 14.0 IEER	
Condensing units, evaporatively cooled	≥ 135,000 Btu/h			13.5 EER 14.0 IEER	13.5 EER 14.0 IEER	

For SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.

b. Single-phase, air-cooled air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

c. Minimum efficiency as of January 1, 2015.

TABLE C403.2.3(2)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE ^a
				Before 1/1/2016	As of 1/1/2016	
Air cooled (cooling mode)	< 65,000 Btu/h ^b	All	Split System	13.0 SEER ^c	14.0 SEER ^c	AHRI 210/240
			Single Package	13.0 SEER ^c	14.0 SEER ^c	
Through-the-wall, air cooled	≤ 30,000 Btu/h ^b	All	Split System	12.0 SEER	12.0 SEER	
			Single Package	12.0 SEER	12.0 SEER	
Single-duct high-velocity air cooled	< 65,000 Btu/h ^b	All	Split System	11.0 SEER	11.0 SEER	
Air cooled (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 12.0 IEER	AHRI 340/360
		All other	Split System and Single Package	10.8 EER 11.0 IEER	10.8 EER 11.8 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.6 EER 10.7 IEER	10.6 EER 11.6 IEER	
		All other	Split System and Single Package	10.4 EER 10.5 IEER	10.4 EER 11.4 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER 9.6 IEER	9.5 EER 10.6 IEER	
		All other	Split System and Single Package	9.3 EER 9.4 IEER	9.3 EER 9.4 IEER	
Water to Air: Water Loop (cooling mode)	< 17,000 Btu/h	All	86°F entering water	12.2 EER	12.2 EER	ISO 13256-1
	≥ 17,000 Btu/h and < 65,000 Btu/h	All	86°F entering water	13.0 EER	13.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	86°F entering water	13.0 EER	13.0 EER	
Water to Air: Ground Water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	18.0 EER	18.0 EER	ISO 13256-1
Brine to Air: Ground Loop (cooling mode)	< 135,000 Btu/h	All	77°F entering water	14.1 EER	14.1 EER	ISO 13256-1
Water to Water: Water Loop (cooling mode)	< 135,000 Btu/h	All	86°F entering water	10.6 EER	10.6 EER	ISO 13256-2
Water to Water: Ground Water (cooling mode)	< 135,000 Btu/h	All	59°F entering water	16.3 EER	16.3 EER	
Brine to Water: Ground Loop (cooling mode)	< 135,000 Btu/h	All	77°F entering fluid	12.1 EER	12.1 EER	

(continued)

TABLE C403.2.3(2)—continued
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE ^a
				Before 1/1/2016	As of 1/1/2016	
Air cooled (heating mode)	< 65,000 Btu/h ^b	—	Split System	7.7 HSPF ^c	8.2 HSPF ^c	AHRI 210/240
		—	Single Package	7.7 HSPF ^c	8.0 HSPF ^c	
Through-the-wall, (air cooled, heating mode)	≤ 30,000 Btu/h ^b (cooling capacity)	—	Split System	7.4 HSPF	7.4 HSPF	
		—	Single Package	7.4 HSPF	7.4 HSPF	
Small-duct high velocity (air cooled, heating mode)	< 65,000 Btu/h ^b	—	Split System	6.8 HSPF	6.8 HSPF	
Air cooled (heating mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.3 COP	3.3 COP	AHRI 340/360
			17°F db/15°F wb outdoor air	2.25 COP	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.2 COP	3.2 COP	
			17°F db/15°F wb outdoor air	2.05 COP	2.05 COP	
Water to Air: Water Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	68°F entering water	4.3 COP	4.3 COP	ISO 13256-1
Water to Air: Ground Water (heating mode)	< 135,000 Btu/h (cooling capacity)	—	50°F entering water	3.7 COP	3.7 COP	
Brine to Air: Ground Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	32°F entering fluid	3.2 COP	3.2 COP	
Water to Water: Water Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	68°F entering water	3.7 COP	3.7 COP	ISO 13256-2
Water to Water: Ground Water (heating mode)	< 135,000 Btu/h (cooling capacity)	—	50°F entering water	3.1 COP	3.1 COP	
Brine to Water: Ground Loop (heating mode)	< 135,000 Btu/h (cooling capacity)	—	32°F entering fluid	2.5 COP	2.5 COP	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.
b. Single-phase, air-cooled air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.
c. Minimum efficiency as of January 1, 2015.

TABLE C403.2.3(3)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS,
PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS,
SINGLE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
PTAC (cooling mode) new construction	All Capacities	95°F db outdoor air	14.0 – (0.300 × Cap/1000) EER ^c	AHRI 310/380
PTAC (cooling mode) replacements ^b	All Capacities	95°F db outdoor air	10.9 - (0.213 × Cap/1000) EER	
PTHP (cooling mode) new construction	All Capacities	95°F db outdoor air	14.0 - (0.300 × Cap/1000) EER	
PTHP (cooling mode) replacements ^b	All Capacities	95°F db outdoor air	10.8 - (0.213 × Cap/1000) EER	
PTHP (heating mode) new construction	All Capacities	—	3.2 - (0.026 × Cap/1000) COP	
PTHP (heating mode) replacements ^b	All Capacities	—	2.9 - (0.026 × Cap/1000) COP	
SPVAC (cooling mode)	< 65,000 Btu/h	95°F db/ 75°F wb outdoor air	9.0 EER	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/ 75°F wb outdoor air	8.6 EER	
SPVHP (cooling mode)	< 65,000 Btu/h	95°F db/ 75°F wb outdoor air	9.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/ 75°F wb outdoor air	8.6 EER	
SPVHP (heating mode)	< 65,000 Btu/h	47°F db/ 43°F wb outdoor air	3.0 COP	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	47°F db/ 43°F wb outdoor air	3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47°F db/ 75°F wb outdoor air	2.9 COP	
Room air conditioners, with louvered sides	< 6,000 Btu/h	—	9.7 SEER	ANSI/ AHAM RAC-1
	≥ 6,000 Btu/h and < 8,000 Btu/h	—	9.7 EER	
	≥ 8,000 Btu/h and < 14,000 Btu/h	—	9.8 EER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	—	9.7 SEER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air conditioners, without louvered sides	< 8,000 Btu/h	—	9.0 EER	
	≥ 8,000 Btu/h and < 20,000 Btu/h	—	8.5 EER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air-conditioner heat pumps with louvered sides	< 20,000 Btu/h	—	9.0 EER	
	≥ 20,000 Btu/h	—	8.5 EER	
Room air-conditioner heat pumps without louvered sides	< 14,000 Btu/h	—	8.5 EER	
	≥ 14,000 Btu/h	—	8.0 EER	

(continued)

TABLE C403.2.3(3)—continued
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS,
PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS,
SINGLE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
Room air conditioner casement only	All capacities	—	8.7 EER	ANSI/AHAM RAC-1
Room air conditioner casement-slider	All capacities	—	9.5 EER	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8, wb = wet bulb, db = dry bulb.

“Cap” = The rated cooling capacity of the project in Btu/h. Where the unit’s capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. Where the unit’s capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculations.

- Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- Replacement unit shall be factory labeled as follows: “MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS.” Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) in height and less than 42 inches (1067 mm) in width.
- Before January 1, 2015, the minimum efficiency shall be 13.8 - (0.300 x Cap/1000) EER.

TABLE 403.2.3(4)
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS,
WARM-AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^{d, e}	TEST PROCEDURE ^a
Warm air furnaces, gas-fired	< 225,000 Btu/h	—	80% AFUE or 80% E_t^c	DOE 10 CFR, Part 430 or Section 2.39, Thermal Efficiency of ANSI Z 21.47
Non-weatherized			81% AFUE	
Weatherized gas furnace	≥ 225,000 Btu/h	Maximum capacity ^c	80% E_t^f	Section 2.39, Thermal Efficiency of ANSI Z21.47
Warm air furnaces, oil-fired	< 225,000 Btu/h	—	83% AFUE or 80% E_t^c	DOE 10 CFR, Part 430 or Section 42, Combustion, of UL 727
Non-weatherized			78% AFUE	
Weatherized oil-fired furnace	≥ 225,000 Btu/h	Maximum capacity ^b	81% E_t^g	Section 42, Combustion, of UL 727
Warm air duct furnaces, gas-fired	All capacities	Maximum capacity ^b	80% E_c	Section 2.10, Efficiency of ANSI Z83.8
Warm air unit heaters, gas-fired	All capacities	Maximum capacity ^b	80% E_c	Section 2.10, Efficiency of ANSI Z83.8
Warm air unit heaters, oil-fired	All capacities	Maximum capacity ^b	80% E_c	Section 40, Combustion, of UL 731
Mobile home furnace, gas-fired	< 225,000 Btu/h	—	80% AFUE	DOE 10 CFR, Part 430
Mobile home furnace, oil-fired	< 225,000 Btu/h	—	75% AFUE	DOE 10 CFR, Part 430

For SI: 1 British thermal unit per hour = 0.2931 W.

- Chapter 6, Referenced Standards, contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- Minimum and maximum ratings as provided for and allowed by the unit’s controls.
- Combination units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.
- E_t = Thermal efficiency. See test procedure for detailed discussion.
- E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.
- E_c = Combustion efficiency. Units shall also include an IID, have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
- E_t = Thermal efficiency. Units shall also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

TABLE C403.2.3(5)
MINIMUM EFFICIENCY REQUIREMENTS: GAS- AND OIL-FIRED BOILERS

EQUIPMENT TYPE ^a	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY ^{d, e}	TEST PROCEDURE
Boilers, hot water	Gas-fired	< 300,000 Btu/h	80% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	80% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	82% E_c	
	Oil-fired ^c	< 300,000 Btu/h	80% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	82% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	84% E_c	
Boilers, steam	Gas-fired	< 300,000 Btu/h	75% AFUE	10 CFR Part 430
	Gas-fired- all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	79% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	79% E_t	
	Gas-fired-natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	77% E_t	
		> 2,500,000 Btu/h ^a	77% E_t	
	Oil-fired ^c	< 300,000 Btu/h	80% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	81% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	81% E_t	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.
- b. Maximum capacity – minimum and maximum ratings as provided for and allowed by the unit's controls.
- c. Includes oil-fired (residual).
- d. E_c = Combustion efficiency (100 percent less flue losses).
- e. E_t = Thermal efficiency. See referenced standard for detailed information.

TABLE C403.2.3(6)
MINIMUM EFFICIENCY REQUIREMENTS:
CONDENSING UNITS, ELECTRICALLY OPERATED

EQUIPMENT TYPE	SIZE CATEGORY	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Condensing units, air cooled	≥ 135,000 Btu/h	10.1 EER 11.2 IPLV	AHRI 365
Condensing units, water or evaporatively cooled	≥ 135,000 Btu/h	13.1 EER 13.1 IPLV	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. IPLVs are only applicable to equipment with capacity modulation.

TABLE C403.2.3(7)
WATER CHILLING PACKAGES – EFFICIENCY REQUIREMENTS^{a, b, d}

EQUIPMENT TYPE	SIZE CATEGORY	UNITS	BEFORE 1/1/2015		AS OF 1/1/2015		TEST PROCEDURE ^c
			Path A	Path B	Path A	Path B	
Air-cooled chillers	< 150 tons	EER (Btu/W)	≥ 9.562 FL	NA ^c	≥ 10.100 FL	≥ 9.700 FL	AHRI 550/590
			≥ 12.500 IPLV		≥ 13.700 IPLV	≥ 15,800 IPLV	
	≥ 150 tons		≥ 9.562 FL	NA ^c	≥ 10.100 FL	≥ 9.700 FL	
			≥ 12.500 IPLV		≥ 14.000 IPLV	≥ 16.100 IPLV	
Air cooled without condenser, electrically operated	All capacities	EER (Btu/W)	Air-cooled chillers without condenser shall be rated with matching condensers and complying with air-cooled chiller efficiency requirements.				
Water cooled, electrically operated positive displacement	< 75 tons	kW/ton	≤ 0.780 FL	≤ 0.800 FL	≤ 0.750 FL	≤ 0.780 FL	
			≤ 0.630 IPLV	≤ 0.600 IPLV	≤ 0.600 IPLV	≤ 0.500 IPLV	
	≥ 75 tons and < 150 tons		≤ 0.775 FL	≤ 0.790 FL	≤ 0.720 FL	≤ 0.750 FL	
			≤ 0.615 IPLV	≤ 0.586 IPLV	≤ 0.560 IPLV	≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons		≤ 0.680 FL	≤ 0.718 FL	≤ 0.660 FL	≤ 0.680 FL	
			≤ 0.580 IPLV	≤ 0.540 IPLV	≤ 0.540 IPLV	≤ 0.440 IPLV	
	≥ 300 tons and < 600 tons		≤ 0.620 FL	≤ 0.639 FL	≤ 0.610 FL	≤ 0.625 FL	
			≤ 0.540 IPLV	≤ 0.490 IPLV	≤ 0.520 IPLV	≤ 0.410 IPLV	
≥ 600 tons	≤ 0.620 FL	≤ 0.639 FL	≤ 0.560 FL	≤ 0.585 FL			
	≤ 0.540 IPLV	≤ 0.490 IPLV	≤ 0.500 IPLV	≤ 0.380 IPLV			
Water cooled, electrically operated centrifugal	< 150 tons	kW/ton	≤ 0.634 FL	≤ 0.639 FL	≤ 0.610 FL	≤ 0.695 FL	
			≤ 0.596 IPLV	≤ 0.450 IPLV	≤ 0.550 IPLV	≤ 0.440 IPLV	
	≥ 150 tons and < 300 tons		≤ 0.634 FL	≤ 0.639 FL	≤ 0.610 FL	≤ 0.635 FL	
			≤ 0.596 IPLV	≤ 0.450 IPLV	≤ 0.550 IPLV	≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons		≤ 0.576 FL	≤ 0.600 FL	≤ 0.560 FL	≤ 0.595 FL	
			≤ 0.549 IPLV	≤ 0.400 IPLV	≤ 0.520 IPLV	≤ 0.390 IPLV	
	≥ 400 tons and < 600 tons		≤ 0.576 FL	≤ 0.600 FL	≤ 0.560 FL	≤ 0.585 FL	
			≤ 0.549 IPLV	≤ 0.400 IPLV	≤ 0.500 IPLV	≤ 0.380 IPLV	
≥ 600 tons	≤ 0.570 FL	≤ 0.590 FL	≤ 0.560 FL	≤ 0.585 FL			
	≤ 0.539 IPLV	≤ 0.400 IPLV	≤ 0.500 IPLV	≤ 0.380 IPLV			
Air cooled, absorption, single effect	All capacities	COP	≥ 0.600 FL	NA ^c	≥ 0.600 FL	NA ^c	AHRI 560
Water cooled absorption, single effect	All capacities	COP	≥ 0.700 FL	NA ^c	≥ 0.700 FL	NA ^c	
Absorption, double effect, indirect fired	All capacities	COP	≥ 1.000 FL	NA ^c	≥ 1.000 FL	NA ^c	
			≥ 1.050 IPLV		≥ 1.050 IPLV		
Absorption double effect direct fired	All capacities	COP	≥ 1.000 FL	NA ^c	≥ 1.000 FL	NA ^c	
			≥ 1.000 IPLV		≥ 1.050 IPLV		

- a. The requirements for centrifugal chiller shall be adjusted for nonstandard rating conditions in accordance with Subsection C403.2.3.1 and are only applicable for the range of conditions listed in Subsection C403.2.3.1. The requirements for air-cooled, water-cooled positive displacement and absorption chillers are at standard rating conditions defined in the reference test procedure.
- b. Both the full-load and IPLV requirements shall be met or exceeded to comply with this standard. Where there is a Path B, compliance can be with either Path A or Path B for any application.
- c. NA means the requirements are not applicable for Path B and only Path A can be used for compliance.
- d. FL represents the full-load performance requirements and IPLV the part-load performance requirements.

TABLE C403.2.3(8)
MINIMUM EFFICIENCY REQUIREMENTS:
HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE ^a	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION ⁱ	PERFORMANCE REQUIRED ^{b, c, d, g, h}	TEST PROCEDURE ^{e, f}
Propeller or axial fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 40.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 14.0 gpm/hp	CTI ATC-105S and CTI STD-201
Centrifugal fan closed- circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI STD-201
Propeller or axial fan evaporative condensers	All	Ammonia Test Fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥ 134,000 Btu/h·hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	Ammonia Test Fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥ 110,000 Btu/h·hp	CTI ATC-106
Propeller or axial fan evaporative condensers	All	R-507A Test Fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥ 157,000 Btu/h·hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	R-507A Test Fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥ 135,000 Btu/h·hp	CTI ATC-106
Air-cooled condensers	All	125°F Condensing Temperature 190°F Entering Gas Temperature 15°F subcooling 95°F entering db	≥ 176,000 Btu/h·hp	AHRI 460

For SI: °C = [(°F)-32]/1.8, L/s · kW = (gpm/hp)/(11.83), COP = (Btu/h · hp)/(2550.7),

db = dry bulb temperature, °F, wb = wet bulb temperature, °F.

- The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of wet and dry heat exchange sections.
- For purposes of this table, open circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 403.2.3(8) divided by the fan nameplate-rated motor power.
- For purposes of this table, closed-circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 403.2.3(8) divided by the sum of the fan nameplate-rated motor power and the spray pump nameplate-rated motor power.
- For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan nameplate-rated motor power.
- Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure. The certification requirements do not apply to field-erected cooling towers.
- Where a certification program exists for a covered product and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program; or, where a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report.
- Cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories and/or options included in the capacity of the cooling tower.
- For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.
- Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A shall meet the minimum efficiency requirements listed in this table with R-507A as the test fluid.

TABLE C403.2.3(9)
MINIMUM EFFICIENCY AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS

EQUIPMENT TYPE	NET SENSIBLE COOLING CAPACITY ^a	MINIMUM SCOP-127 ^b EFFICIENCY DOWNFLOW UNITS / UPFLOW UNITS	TEST PROCEDURE
Air conditioners, air cooled	< 65,000 Btu/h	2.20 / 2.09	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99	
	≥ 240,000 Btu/h	1.90 / 1.79	
Air conditioners, water cooled	< 65,000 Btu/h	2.60 / 2.49	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.50 / 2.39	
	≥ 240,000 Btu/h	2.40 / 2.29	
Air conditioners, water cooled with fluid economizer	< 65,000 Btu/h	2.55 / 2.44	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.45 / 2.34	
	≥ 240,000 Btu/h	2.35 / 2.24	
Air conditioners, glycol cooled (rated at 40% propylene glycol)	< 65,000 Btu/h	2.50 / 2.39	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.15 / 2.04	
	≥ 240,000 Btu/h	2.10 / 1.99	
Air conditioners, glycol cooled (rated at 40% propylene glycol) with fluid economizer	< 65,000 Btu/h	2.45 / 2.34	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99	
	≥ 240,000 Btu/h	2.05 / 1.94	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Net sensible cooling capacity: the total gross cooling capacity less the latent cooling less the energy to the air movement system. (Total Gross – latent – Fan Power).
- b. Sensible coefficient of performance (SCOP-127): a ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding reheaters and humidifiers) at conditions defined in ASHRAE Standard 127. The net sensible cooling capacity is the gross sensible capacity minus the energy dissipated into the cooled space by the fan system.

TABLE C403.2.3(10)
HEAT TRANSFER EQUIPMENT

EQUIPMENT TYPE	SUBCATEGORY	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
Liquid-to-liquid heat exchangers	Plate type	NR	AHRI 400

NR = No Requirement.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

TABLE C403.2.3(11)
MINIMUM EFFICIENCY REQUIREMENTS
VARIABLE REFRIGERANT FLOW MULTI-SPLIT AIR CONDITIONERS AND HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING TYPE ^a	MINIMUM EFFICIENCY	TEST PROCEDURE ^b
VRF Multi-split Air Conditioners (Air-cooled)	< 65,000 Btu/h	All	13.0 SEER	AHRI 1230 (omit Sections 5.1.2 and 6.6)
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	11.2 EER	
		All other	11.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	11.0 EER	
		All other	10.8 EER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric resistance (or none)	10.0 EER	
		All other	9.8 EER	
VRF Multi-split Heat Pumps (Air-cooled)	< 65,000 Btu/h	All	13.0 SEER 7.7 HSPF	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric resistance (or none)	11.0 EER 3.3 COP	
		All other	10.8 EER 3.3 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric resistance (or none)	10.6 EER 3.2 COP	
		All other	10.4 EER 3.2 COP	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric resistance (or none)	9.5 EER 3.2 COP	
		All other	9.8 EER	
VRF Multi-split Air Conditioners (Water-source)	< 17,000 Btu/h	Without heat recovery	12.0 EER 4.2 COP	
		With heat recovery	11.8 EER 4.2 COP	
	≥ 17,000 Btu/h and < 65,000 Btu/h	All	12.0 EER 4.2 COP	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	12.0 EER 4.2 COP	
	≥ 135,000 Btu/h and < 760,000 Btu/h	Without heat recovery	10.0 EER 3.9 COP	
		With heat recovery	9.8 EER 3.9 COP	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) – 32]/1.8

- a. VRAF Multi-split Heat Pumps (air-cooled) with heat recovery fall under the category of “All Other Types of Heating” unless they also have electric resistance heating, in which case it falls under the category for “No Heating or Electric Resistance Heating.”
- b. Chapter 6, Referenced Standards, contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.

C403.2.3.1 Water-cooled centrifugal chilling packages. Equipment not designed for operation at AHRI Standard 550/590 test conditions of 44°F (7°C) leaving chilled-water temperature and 2.4 gpm/ton evaporator fluid flow and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s · kW) condenser water flow shall have maximum full-load kW/ton (FL) and part-load ratings requirements adjusted using Equations 4-6 and 4-7.

$$FL_{adj} = FL/K_{adj} \quad \text{(Equation 4-6)}$$

$$PLV_{adj} = IPLV/K_{adj} \quad \text{(Equation 4-7)}$$

where:

$$K_{adj} = A \times B$$

FL = Full-load kW/ton value as specified in Table C403.2.3(7).

FL_{adj} = Maximum full-load kW/ton rating, adjusted for nonstandard conditions.

$IPLV$ = Value as specified in Table C403.2.3(7).

PLV_{adj} = Maximum NPLV rating, adjusted for nonstandard conditions.

$$A = 0.00000014592 \cdot (LIFT)^4 - 0.0000346496 \cdot (LIFT)^3 + 0.00314196 \cdot (LIFT)^2 - 0.147199 \cdot (LIFT) + 3.9302$$

$$B = 0.0015 \cdot L_{vg} E_{vap} + 0.934$$

$$LIFT = L_{vg} Cond - L_{vg} E_{vap}$$

$L_{vg}Cond$ = Full-load condenser leaving fluid temperature (°F).

$L_{vg}E_{vap}$ = Full-load evaporator leaving temperature (°F).

The FL_{adj} and PLV_{adj} values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

1. Minimum evaporator leaving temperature: 36°F.
2. Maximum condenser leaving temperature: 115°F.
3. $20^{\circ}\text{F} \leq LIFT \leq 80^{\circ}\text{F}$.

C403.2.3.2 Positive displacement (air- and water-cooled) chilling packages. Equipment with a leaving fluid temperature higher than 32°F (0°C) and water-cooled positive displacement chilling packages with a condenser leaving fluid temperature below 115°F (46°C) shall meet the requirements of Table C403.2.3(7) when tested or certified with water at standard rating conditions, in accordance with the referenced test procedure.

C403.2.4 HVAC system controls. Each heating and cooling system shall be provided with thermostatic controls as specified in Subsection C403.2.4.1, C403.2.4.1.3, C403.2.4.2, C403.2.4.3, C403.3.1, C403.4, C403.4.1 or C403.4.4.

C403.2.4.1 Thermostatic controls. The supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls capable of responding to temperature within the zone. Where humidification or dehumidification or both is provided, at least one humidity control device shall be provided for each humidity control system.

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses, gains or both serving one or more perimeter zones also served by an interior system provided:

1. The perimeter system includes at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation (within +/-45 degrees) (0.8 rad) for more than 50 contiguous feet (15 240 mm); and
2. The perimeter system heating and cooling supply is controlled by thermostats located within the zones served by the system.

C403.2.4.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation where the heat pump can provide the heating load.

C403.2.4.1.2 Deadband. Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or deadband of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the zone is capable of being shut off or reduced to a minimum.

Exceptions:

1. Thermostats requiring manual changeover between heating and cooling modes.

2. Occupancies or applications requiring precision in indoor temperature control as approved by the Building Official.

C403.2.4.1.3 Set point overlap restriction. Where a zone has a separate heating and a separate cooling thermostatic control located within the zone, a limit switch, mechanical stop or direct digital control system with software programming shall be provided with the capability to prevent the heating set point from exceeding the cooling set point and to maintain a deadband in accordance with Subsection C403.2.4.1.2.

C403.2.4.2 Off-hour controls. Each zone shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.

Exceptions:

1. Zones that will be operated continuously.
2. Zones with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch.

C403.2.4.2.1 Thermostatic setback capabilities. Thermostatic setback controls shall have the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C).

C403.2.4.2.2 Automatic setback and shutdown capabilities. Automatic time clock or programmable controls shall be capable of starting and stopping the system for seven different daily schedules per week and retaining their programming and time setting during a loss of power for at least 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer capable of being adjusted to operate the system for up to 2 hours; or an occupancy sensor.

C403.2.4.2.3 Automatic start capabilities. Automatic start controls shall be provided for each HVAC system. The controls shall be capable of automatically adjusting the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy.

C403.2.4.2.4 Humidistatic control. Where humidification, dehumidification or both is provided, the following shall be met:

1. At least one humidity control device shall be provided for each humidity control system.
2. Controls shall be provided capable of preventing simultaneous operation of humidification and dehumidification equipment.

Exceptions:

1. Zones served by desiccant systems used with direct evaporative cooling in series.

2. Systems serving zones where specific humidity levels are required, such as computer rooms, museums and hospitals, as approved by the Building Official.

C403.2.4.3 Shutoff dampers. Outdoor air intake and exhaust openings and stairway and shaft vents shall be provided with Class I motorized dampers. The dampers shall have an air leakage rate not greater than 4 cfm/ft² (20.3 L/s · m²) of damper surface area at 1.0 inch water gauge (249 Pa) and shall be labeled by an approved agency when tested in accordance with AMCA 500D for such purpose.

Outdoor air intake and exhaust dampers shall be installed with automatic controls configured to close when the systems or spaces served are not in use or during unoccupied period warm-up and setback operation, unless the systems served require outdoor or exhaust air in accordance with the *EPCOT Mechanical Code* or the dampers are opened to provide intentional economizer cooling.

Stairway and shaft vent dampers shall be installed with automatic controls configured to open upon the activation of any fire alarm initiating device of the building's fire alarm system or the interruption of power to the damper.

Exception: Gravity (nonmotorized) dampers shall be permitted to be used as follows:

1. In buildings less than three stories in height above grade plane.
2. In buildings of any height located in Climate Zones 1, 2 or 3.
3. Where the design exhaust capacity is not greater than 300 cfm (142 L/s).

Gravity (nonmotorized) dampers shall have an air leakage rate not greater than 20 cfm/ft² (101.6 L/s · m²) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft² (203.2 L/s · m²) where less than 24 inches (610 mm) in either dimension. The rate of air leakage shall be determined at 1.0 inch water gauge (249 Pa) when tested in accordance with AMCA 500D for such purpose. The dampers shall be labeled by an approved agency.

C403.2.4.4 Zone isolation. HVAC systems serving zones that are over 25,000 square feet (2323 m²) in floor area or that span more than one floor and are designed to operate or be occupied nonsimultaneously shall be divided into isolation areas. Each isolation area shall be equipped with isolation devices and controls configured to automatically shut off the supply of conditioned air and outdoor air to and exhaust air from the isolation area. Each isolation area shall be controlled independently by a device meeting the requirements of Subsection C403.2.4.2.2. Central systems and plants shall be provided with controls and devices that will allow system and equipment operation for any length of time while

serving only the smallest isolation area served by the system or plant.

Exceptions:

1. Exhaust air and outdoor air connections to isolation areas where the fan system to which they connect is not greater than 5,000 cfm (2360 L/s).
2. Exhaust airflow from a single isolation area of less than 10 percent of the design airflow of the exhaust system to which it connects.
3. Isolation areas intended to operate continuously or intended to be inoperative only when all other isolation areas in a zone are inoperative.

C403.2.4.5 Snow- and ice-melt system controls. Snow- and ice-melting systems shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C) and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (4°C).

C403.2.4.6 Freeze protection system controls. Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls configured to shut off the systems when outdoor air temperatures are above 40°F (4°C) or when the conditions of the protected fluid will prevent freezing.

C403.2.4.7 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units listed in Tables C403.2.3(1) through C403.2.3(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Subsection C403.3 shall include a fault detection and diagnostics (FDD) system complying with the following:

1. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1.1. Outside air.
 - 1.2. Supply air.
 - 1.3. Return air.
2. Temperature sensors shall have an accuracy of ±2°F (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C).
3. Refrigerant pressure sensors, where used, shall have an accuracy of ±3 percent of full scale.
4. The unit controller shall be capable of providing system status by indicating the following:
 - 4.1. Free cooling available.
 - 4.2. Economizer enabled.
 - 4.3. Compressor enabled.
 - 4.4. Heating enabled.
 - 4.5. Mixed air low limit cycle active.
 - 4.6. The current value of each sensor.
5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the

heating system can be independently tested and verified.

6. The unit shall be capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
7. The FDD system shall be capable of detecting the following faults:
 - 7.1. Air temperature sensor failure/fault.
 - 7.2. Not economizing when the unit should be economizing.
 - 7.3. Economizing when the unit should not be economizing.
 - 7.4. Damper not modulating.
 - 7.5. Excess outdoor air.

C403.2.5 Hot water boiler outdoor temperature setback control. Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

C403.2.6 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with the *EPCOT Mechanical Code*. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by the *EPCOT Mechanical Code*.

C403.2.6.1 Demand controlled ventilation. Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m²) and with an average occupant load of 25 people per 1,000 square feet (93 m²) of floor area (as established in the *EPCOT Mechanical Code*) and served by systems with one or more of the following:

1. An air-side economizer.
2. Automatic modulating control of the outdoor air damper.
3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).

Exception: Demand control ventilation is not required for systems and spaces as follows:

1. Systems with energy recovery complying with Subsection C403.2.7.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. Systems with a design outdoor airflow less than 1,200 cfm (566 L/s).
4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (566 L/s).
5. Ventilation provided for process loads only.

C403.2.6.2 Enclosed parking garage ventilation controls. Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ contamination-sensing devices and auto-

matic controls configured to stage fans or modulate fan average airflow rates to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with *EPCOT Mechanical Code* provisions. Failure of contamination sensing devices shall cause the exhaust fans to operate continuously at design airflow.

Exceptions:

1. Garages with a total exhaust capacity less than 22,500 cfm (10 620 L/s) with ventilation systems that do not utilize heating or mechanical cooling.
2. Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.

C403.2.7 Energy recovery ventilation systems. Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.2.7(1) and C403.2.7(2), the system shall include an energy recovery system. The energy recovery system shall have the capability to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls which permit operation of the economizer as required by Subsection C403.3.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the *EPCOT Mechanical Code*.
2. Laboratory fume hood systems that include at least one of the following features:
 - 2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
 - 2.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are heated to less than 60°F (15.5°C) and are not cooled.
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
5. Heating energy recovery in Climate Zones 1 and 2.
6. Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.
7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.

8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design outdoor air flow rate.
9. Systems expected to operate less than 20 hours per week at the outdoor air percentage covered by Table C403.2.7(1).
10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

C403.2.8 Kitchen exhaust systems. Replacement air introduced directly into the exhaust hood cavity shall not be greater than 10 percent of the hood exhaust airflow rate. Conditioned supply air delivered to any space shall not exceed the greater of the following:

1. The ventilation rate required to meet the space heating or cooling load.
2. The hood exhaust flow minus the available transfer air from adjacent space where available transfer air is considered that portion of outdoor ventilation air not required to satisfy other exhaust needs, such as restrooms, and not required to maintain pressurization of adjacent spaces.

Where total kitchen hood exhaust airflow rate is greater than 5,000 cfm (2360 L/s), each hood shall be a factory-

built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710. Each hood shall have a maximum exhaust rate as specified in Table C403.2.8 and shall comply with one of the following:

1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.
2. Demand ventilation systems on not less than 75 percent of the exhaust air that are capable of not less than a 50-percent reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.
3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust airflow.

Where a single hood, or hood section, is installed over appliances with different duty ratings, the maximum allowable flow rate for the hood or hood section shall be based on the requirements for the highest appliance duty rating under the hood or hood section.

Exception: Where not less than 75 percent of all the replacement air is transfer air that would otherwise be exhausted

TABLE C403.2.7(1)
ENERGY RECOVERY REQUIREMENT
(Ventilation systems operating less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 5C	NR	NR	NR	NR	≥ 26,000	≥ 12,000	≥ 5,000	≥ 4,000
6B	≥ 28,000	≥ 26,500	≥ 11,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,500	≥ 1,500
1A, 2A, 3A, 4A, 5A, 6A	≥ 26,000	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 0
7, 8	≥ 4,500	≥ 4,000	≥ 2,500	≥ 1,000	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.
NR = Not Required.

TABLE C403.2.7(2)
ENERGY RECOVERY REQUIREMENT
(Ventilation systems operating not less than 8,000 hours per year)

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	Design Supply Fan Airflow Rate (cfm)							
3C	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 3B, 4C, 5C	NR	≥ 19,500	≥ 9,000	≥ 5,000	≥ 4,000	≥ 3,000	≥ 1,500	> 0
1A, 2A, 3A, 4B, 5B	≥ 2,500	≥ 2,000	≥ 1,000	≥ 500	> 0	> 0	> 0	> 0
4A, 5A, 6A, 6B, 7, 8	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0

For SI: 1 cfm = 0.4719 L/s.
NR = Not required

TABLE C403.2.8
MAXIMUM NET EXHAUST FLOW RATE,
CFM PER LINEAR FOOT OF HOOD LENGTH

TYPE OF HOOD	LIGHT-DUTY EQUIPMENT	MEDIUM-DUTY EQUIPMENT	HEAVY-DUTY EQUIPMENT	EXTRA-HEAVY-DUTY EQUIPMENT
Wall-mounted canopy	140	210	280	385
Single island	280	350	420	490
Double island (per side)	175	210	280	385
Eyebrow	175	175	NA	NA
Backshelf/Pass-over	210	210	280	NA

For SI: 1 cfm = 0.4719 L/s; 1 foot = 305 mm.

NA = Not Allowed.

C403.2.9 Duct and plenum insulation, construction and sealing (Mandatory).

C403.2.9.1 Insulation.

C403.2.9.1.1 Insulation required. All supply and return air ducts and plenums shall be insulated to the levels shown in Table C403.2.9.1.

Exceptions:

1. When located within equipment.
2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (8°C).
3. For runouts less than 10 feet (3048 mm) in length to air terminals or air outlets, the rated *R*-value of insulation need not exceed R-5.
4. Backs of air outlets and outlet plenums exposed to unconditioned or indirectly conditioned spaces with face areas exceeding 5 square feet (.46 m²) need not exceed R-2; those 5 square feet (.46 m²) or smaller need not be insulated.
5. Return air ducts meeting all the requirements for building cavities that will be used as return air plenums.

TABLE C403.2.9.1
MINIMUM DUCT INSULATION R-VALUES,
HEATING AND COOLING SUPPLY AND RETURN DUCTS

LOCATION	SUPPLY DUCT	RETURN DUCT
Exterior of building	R-6	R-4.2
Ventilated Attic	R-6	R-4.2
Unvented attic above insulated ceiling	R-6	R-4.2
Unvented attic with roof insulation	R-4.2	None
Unconditioned spaces ¹	R-4.2	R-4.2
Indirectly conditioned spaces ²	None	None
Conditioned spaces	None	None
Buried	R-4.2	None

1. Includes crawl spaces, both ventilated and nonventilated.

2. Includes return air plenums with or without exposed roofs above.

C403.2.9.1.2 Insulation protection. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, but not limited to the following:

1. Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.
2. Insulation covering cooling ducts located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed.

C403.2.9.1.3 Condensation control. Additional insulation with vapor barrier shall be provided where the minimum duct insulation requirements of Subsection C403.2.9.1.1 are determined to be insufficient to prevent condensation.

C403.2.9.2 Duct construction. All ducts, air handlers, filter boxes, building cavities, mechanical closets and enclosed support platforms that form the primary air containment passageways for air distribution systems shall be considered ducts or plenum chambers and shall be constructed and erected in accordance with the *EPCOT Mechanical Code*. Ducts shall be constructed, braced, reinforced and installed to provide structural strength and durability. All transverse joints, longitudinal seams and fitting connections shall be securely fastened in accordance with the applicable standards of this Section.

C403.2.9.3 Sealing, general (Mandatory). All ducts, air handlers, filter boxes, building cavities, mechanical closets and enclosed support platforms that form the primary air containment passageways for air distribution systems shall be sealed in accordance with the applicable criteria of this Section and Table C403.2.9.2.

C403.2.9.3.1 Mechanical fastening. All joints between sections of air ducts and plenums, between

intermediate and terminal fittings and other components of air distribution systems, and between subsections of these components shall be mechanically fastened to secure the sections independently of the closure system(s).

C403.2.9.3.2 Sealing. Air distribution system components shall be sealed with approved closure systems.

C403.2.9.3.3 Space provided. Sufficient space shall be provided adjacent to all mechanical components

located in or forming a part of the air distribution system to assure adequate access for: (1) construction and sealing in accordance with the requirements of Subsection C403.2.9, (2) inspection and (3) cleaning and maintenance. A minimum of 4 inches (102 mm) is considered sufficient space around air-handling units.

Exception: Retrofit or replacement units not part of a renovation.

TABLE C403.2.9.2
DUCT SYSTEM CONSTRUCTION AND SEALING

DUCT TYPE/ CONNECTION	SEALING REQUIREMENTS	MECHANICAL ATTACHMENT	TEST STANDARD
Metal duct, rigid and flexible			
Pressures less than 1-inch water gauge	Closure systems as described in Subsection C403.2.9.3: 1. Continuous welds. 2. Snaplock seams and grooved, standing, double-corner, single-corner and Pittsburgh-lock seams and all other rolled mechanical seams. 3. Mastic, mastic-plus-embedded fabric or mastic ribbons. 4. Gaskets. 5. Pressure-sensitive tape. 6. Aerosol sealant.	Mechanical attachments approved: 1. Continuous welds. 2. Snaplock seams and grooved, standing, double corner, single-corner and Pittsburgh-lock seams and all other rolled mechanical seams. Crimp joints for round metal ducts shall have a contact lap of at least 1½ inches (38 mm). Round metal ducts shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint. ¹	SMACNA HVAC Air Duct Leakage Test Manual
Pressures 1-inch water gauge or greater	Closure systems as described in Subsection C403.2.9.3: 1. Continuous welds. 2. Mastic or mastic-plus-embedded fabric systems. 3. Gaskets.	Mechanical attachments approved: Continuous welds. Round metal ducts shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint. ¹	SMACNA HVAC Air Duct Leakage Test Manual
High-pressure duct systems designed to operate at pressures greater than 3-inch water gauge (4-inch water gauge pressure class)	The tested duct leakage class, at a test pressure equal to the design duct pressure class rating, shall be equal to or less than Leakage Class 6. Leakage testing may be limited to representative sections of the duct system but in no case shall such tested sections include less than 25 percent of the total installed duct area for the designated pressure class.		SMACNA HVAC Air Duct Leakage Test Manual
Plastic duct	See the <i>EPCOT Mechanical Code</i> .	Joints between plastic ducts and plastic fittings shall be made in accordance with the manufacturer's installation instructions.	ASTM D2412
Fibrous glass duct, rigid	All joints, seams and duct wall penetrations between sections of duct and between duct and other distribution system components shall be sealed with closure systems as described in Subsection C403.2.9.3: 1. Heat-activated tapes. 2. Pressure-sensitive tapes. 3. Mastics or mastic-plus-embedded fabric systems.	Mechanically fastened per standard to secure the sections independent of the closure system(s). Attachments of ductwork to air-handling equipment shall be by mechanical fasteners. Where access is limited, two fasteners on one side shall be acceptable.	NAIMA Fibrous Glass Duct Construction Standards UL 181 UL 181A
Flexible duct systems, nonmetal	All duct collar fittings shall have a minimum 5⁄8-inch (16 mm) integral flange for sealing to other components and a minimum 3-inch (76 mm) shaft for insertion into the inner duct core. Flexible ducts having porous inner cores shall not be used. Exception: Ducts having a nonporous liner between the porous inner core and the outer jacket. Fastening and sealing requirements shall be applied to such intermediate liners.	Flexible nonmetal ducts shall be joined to all other air distribution system components by either terminal or intermediate fittings. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. See the <i>EPCOT Mechanical Code</i> for duct support requirements.	UL 181 UL 181B ADC FDPIS

(continued)

TABLE C403.2.9.2—continued
DUCT SYSTEM CONSTRUCTION AND SEALING

DUCT TYPE/ CONNECTION	SEALING REQUIREMENTS	MECHANICAL ATTACHMENT	TEST STANDARD
Duct core to duct fitting	The reinforced lining shall be sealed to the duct fitting using one of the following sealing materials, which conforms to the approved closure and mechanical attachment requirements of Subsection C403.2.9.3: 1. Gasketing. 2. Mastic, mastic-plus-embedded fabric or mastic ribbons. 3. Pressure-sensitive tape. 4. Aerosol sealants, provided that their use is consistent with UL 181.	The reinforced core shall be mechanically attached to the duct fitting by a drawband installed directly over the wire-reinforced core and the duct fitting. The duct fitting shall extend a minimum of 2 inches (51 mm) into each section of duct core. When the flexible duct is larger than 12 inches (303 mm) in diameter or the design pressure exceeds 1-inch water gauge, the drawband shall be secured by a raised bead or indented groove on the fitting.	
Duct outer jacket to duct collar fitting	The outer jacket of a flexible duct section shall be secured at the juncture of the air distribution system component and intermediate or terminal fitting in such a way as to prevent excess condensation. The outer jacket of a flexible duct section shall not be interposed between the flange of the duct fitting and the flexible duct, rigid fibrous glass duct board or sheet metal to which it is mated.		
Duct collar fitting to rigid duct	The duct collar fitting's integral flange shall be sealed to the rigid duct board or sheet metal using one of the following closure systems/materials, which conforms to the approved closure and mechanical attachment standards of Subsection C403.2.9.3: 1. Gasketing. 2. Mastic or mastic-plus-embedded fabric systems. 3. Mastic ribbons when used to attach a duct collar to sheet metal. 4. Pressure-sensitive tape. 5. Aerosol sealants, provided that their use is consistent with UL 181.	The duct collar fitting shall be mechanically attached to the rigid duct board or sheet metal by appropriate mechanical fasteners, either screws, spin-in flanges or dovetail flanges.	
Terminal and intermediate fittings. Fittings and joints between dissimilar duct types Terminal fittings and air ducts to building envelope components	Approved closure systems shall be as designated by air distribution system component material type in Subsection C403.2.9.3. Exception: When the components of a joint are fibrous glass duct board and metal duct, including collar fittings and metal equipment housings, the closure systems approved for fibrous glass duct shall be used. Terminal fittings and air ducts that penetrate the building envelope shall be mechanically attached to the structure and sealed to the envelope component penetrated and shall use one of the following closure systems/materials which conform to the approved closure and mechanical application requirements of Subsection C403.2.9.3: 1. Mastics or mastic-plus-embedded fabrics. 2. Gaskets used in terminal fitting/grille assemblies that compress the gasket material between the fitting and the wall, ceiling or floor sheathing.		
Air-handling units	Air-handling units located outside the conditioned space shall be sealed using approved closure systems described in Subsection C403.2.9.3 for metallic ducts.	All air-handling units shall be mechanically attached to other air distribution system components.	
Return plenums	Building cavities that will be used as return air plenums shall be lined with a continuous air barrier made of durable nonporous materials. All penetrations to the air barrier shall be sealed with a suitable long-life mastic material. Exception: Surfaces between the plenum and conditioned spaces from which the return/mixed air is drawn. Roof decks above building cavities used as a return air plenum shall be insulated to at least R-19.		

(continued)

TABLE C403.2.9.2—continued
DUCT SYSTEM CONSTRUCTION AND SEALING

DUCT TYPE/ CONNECTION	SEALING REQUIREMENTS	MECHANICAL ATTACHMENT	TEST STANDARD
Mechanical closets	<p>All joints between the air barriers of walls, ceiling, floor and door framing and all penetrations of the air barrier shall be sealed to the air barrier with approved closure systems. Through-wall, through-floor and through-ceiling air passageways into the closet shall be framed and sealed to form an air-tight passageway.</p> <p>Exception: Air passageways into the closet from conditioned space that are specifically designed for return airflow.</p> <p>The following air barriers are approved for use in mechanical closets:</p> <ol style="list-style-type: none"> One-half-inch-thick (12.7 mm) or greater gypsum wallboard, taped and sealed with joint compound over taped joints between gypsum wallboard panels. Other panelized materials having inward facing surfaces with an air porosity no greater than that of a duct product meeting Section 22 of UL 181, which are sealed on all interior surfaces to create a continuous air barrier by one of the following: <ol style="list-style-type: none"> Sealants complying with the product and application standards of this table for fibrous glass ductboard or A suitable long-life caulk or mastic for all applications. 		
Enclosed support platforms in unconditioned spaces	<p>Enclosed support platforms located between the return air inlet(s) from conditioned space and the inlet of the air-handling unit or furnace, shall contain a duct section constructed entirely of rigid metal, rigid fibrous glass duct board or flexible duct, which is constructed and sealed according to the respective requirements of Subsection C403.2.9.2 and insulated according to the requirements of Subsection C403.2.9.1.</p> <ol style="list-style-type: none"> No portion of the building structure, including adjoining walls, floors and ceilings, shall be in contact with the return air stream or function as a component of this duct section. The duct section shall not be penetrated by a refrigerant line, chase, wiring, pipe or any object other than a component of the air distribution system. Through-wall, through-floor and through-ceiling penetrations into the duct system shall contain a branch duct fabricated of rigid fibrous glass duct board or rigid metal and shall extend to and be sealed by both the duct section and the grille side wall surface. 	The branch duct shall be fabricated and attached to the duct insert in accordance with requirements for the duct type used.	

1. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.

C403.2.9.3.4 Product application. Closure products shall be applied to the air barriers of air distribution system components being joined in order to form a continuous barrier or they may be applied in accordance with the manufacturer's instructions or appropriate industry installation standard where more restrictive.

C403.2.9.3.5 Surface preparation. The surfaces upon which closure products are to be applied shall be clean and dry in accordance with the manufacturer's installation instructions.

C403.2.9.3.6 Approved mechanical attachments. Approved mechanical attachments for air distribution system components include screws, rivets, welds, interlocking joints crimped and rolled, staples, twist in (screw attachment), and compression systems created by bend tabs or screw tabs and flanges or by clinching straps. Mechanical attachments shall be selected from Table C403.2.9.2 to be appropriate to the duct system type.

C403.2.9.3.7 Approved closure systems. The following closure systems and materials are approved for air distribution construction and sealing for the applications and pressure classes shown in Table C403.2.9.2:

- Metal closures.
 - Welds applied continuously along metal seams or joints through which air could leak.
 - Snaplock seams and grooved, standing, double-corner, single-corner and Pittsburgh-lock seams, as defined by SMACNA, as well as all other rolled mechanical seams. All seams shall be rolled or crimped.
- Gasketing, which achieves a 25/50 flame spread/smoke-density-development rating under ASTM E84 or UL 723, provided that it is used only between mated surfaces that are mechanically fastened with sufficient force to compress the gasket and to fill all voids and

cracks through which air leakage would otherwise occur.

3. Mastic closures. Mastics shall be placed over the entire joint between mated surfaces. Mastics shall not be diluted. Approved mastics include the following:
 - a. Mastic or mastic-plus-embedded fabric systems applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part III.
 - b. Mastic or mastic-plus-embedded fabric systems applied to nonmetal flexible duct that are listed and labeled in accordance with UL 181B, Part II.
 - c. Mastic ribbons, which achieve a 25/50 flame spread/smoke density development rating under ASTM E84 or UL 723, provided that they may be used only in flange-joints and lap-joints, such that the mastic resides between two parallel surfaces of the air barrier and that those surfaces are mechanically fastened.
4. Tapes. Tapes shall be applied such that they extend not less than 1 inch onto each of the mated surfaces and shall totally cover the joint. When used on rectangular ducts, tapes shall be used only on joints between parallel rigid surfaces and on right angle joints. Approved tapes include the following:
 - a. Pressure-sensitive tapes.
 - i. Pressure-sensitive tapes applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part I.
 - ii. Pressure-sensitive tapes applied to nonmetal flexible duct that are listed and labeled in accordance with UL 181B, Part I.
 - b. Heat-activated tapes applied to fibrous glass ductboard that are listed and labeled in accordance with UL 181A, Part II.
5. Aerosol sealant. Such sealants shall be installed by manufacturer-certified installers following manufacturer's instructions and shall achieve 25/50 flame spread/smoke-density-development ratings under ASTM E84 or UL 723.

C403.2.9.4 Cavities of the building structure. Cavities in framed spaces, such as dropped soffits and walls, shall not be used to deliver air from or return air to the conditioning system unless they contain an air duct insert that is insulated in accordance with Subsection C403.2.9.1 and constructed and sealed in accordance with the requirements of Subsection C403.2.9.2 appropriate for the duct materials used.

Exception: Return air plenums beneath a roof deck that is insulated to at least R-19.

C403.2.9.5 Air distribution system sizing and design. All air distribution systems shall be sized and designed in accordance with recognized engineering standards such as ACCA Manual D or other standards based on the following:

1. Calculation of the supply air for each room shall be based on the greater of the heating load or sensible cooling load for that room.
2. Duct size shall be determined by the supply air requirements of each room, the available static pressure and the total equivalent length of the various duct runs.
3. Friction loss data shall correspond to the type of material used in duct construction.

C403.2.9.6 Air-handling units. Air-handling units shall not be allowed in attics of commercial buildings.

C403.2.10 Piping insulation. Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.2.10.

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this Code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and AHRI 840, respectively.
3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.
6. Direct buried piping that conveys fluids at or below 60°F (15°C).

C403.2.10.1 Protection of piping insulation. Piping insulation exposed to the weather shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

C403.2.11 Mechanical systems commissioning and completion requirements. Mechanical systems shall be commissioned and completed in accordance with Subsection C408.2.

C403.2.12 Air system design and control. Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 hp (3.7 kW) shall comply with the provisions of Subsections C403.2.12.1 through C403.2.12.3.

TABLE C403.2.10
MINIMUM PIPE INSULATION THICKNESS (in inches)^{a, c}

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu · in./(h · ft ² · °F) ^b	Mean Rating Temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 – 0.26	50	0.5	1.0	1.0	1.0	1.5

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

a. For piping smaller than 1½ inches and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\{(1 + t/r)K/k - 1\}$$

where:

T = minimum insulation thickness,

r = actual outside radius of pipe,

t = insulation thickness listed in the table for applicable fluid temperature and pipe size,

K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature Btu · in./(h · ft² · °F) and

k = the upper value of the conductivity range listed in the table for the applicable fluid temperature.

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1½ inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25 mm)).

C403.2.12.1 Allowable fan motor horsepower. Each HVAC system at fan system design conditions shall not exceed the allowable fan system motor nameplate hp (Option 1) or fan system bhp (Option 2) as shown in Table C403.2.12.1(1). This includes supply fans, exhaust fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single-zone variable air volume systems shall comply with the constant volume fan power limitation.

Exceptions:

1. Hospital, vivarium and laboratory systems that utilize flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable volume fan power limitation.
2. Individual exhaust fans with motor nameplate horsepower of 1 hp (0.746 kW) or less are exempt from the allowable fan horsepower requirement.

C403.2.12.2 Motor nameplate horsepower. For each fan, the fan brake horsepower shall be indicated on the construction documents and the selected motor shall be not larger than the first available motor size greater than the following:

1. For fans less than 6 bhp (4413 W), 1.5 times the fan brake horsepower.
2. For fans 6 bhp (4413 W) and larger, 1.3 times the fan brake horsepower.

3. Systems complying with Subsection C403.2.12.1 fan system motor nameplate hp (Option 1).

C403.2.12.3 Fan efficiency. Fans shall have a fan efficiency grade (FEG) of not less than 67 when determined in accordance with AMCA 205 by an approved, independent testing laboratory. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

Exception: The following fans are not required to have a fan efficiency grade:

1. Fans of 5 hp (3.7 kW) or less as follows:
 - 1.1. Single fan with a motor nameplate horsepower of 5 hp (3.7 kW) or less, unless Exception 1.2 applies.
 - 1.2. Multiple fans in series or parallel that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan.
2. Fans that are part of equipment covered under Subsection C403.2.3.
3. Fans included in an equipment package certified by an approved agency for air or energy performance.
4. Powered wall/roof ventilators.
5. Fans outside the scope of AMCA 205.
6. Fans that are intended to operate only during emergency conditions.

TABLE C403.2.12.1(1)
FAN POWER LIMITATION

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \leq CFM_s \cdot 0.0011$	$hp \leq CFM_s \cdot 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \leq CFM_s \cdot 0.00094 + A$	$bhp \leq CFM_s \cdot 0.0013 + A$

For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W, 1 cfm = 0.4719 L/s.

where:

CFM_s = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

hp = The maximum combined motor nameplate horsepower.

Bhp = The maximum combined fan brake horsepower.

A = Sum of $[PD \times CFM_d / 4131]$

where:

PD = Each applicable pressure drop adjustment from Table C403.2.12.1(2) in. w.c.

CFM_d = The design airflow through each applicable device from Table C403.2.12.1(2) in cubic feet per minute.

TABLE C403.2.12.1(2)
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
Credits	
Fully ducted return and/or exhaust air systems	0.5 inch w.c. (2.15 in w.c. for laboratory and vivarium systems)
Return and/or exhaust airflow control devices	0.5 inch w.c.
Exhaust filters, scrubbers or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate filtration credit: MERV 9 thru 12	0.5 inch w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 inch. w.c.
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2× clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Biosafety cabinet	Pressure drop of device at fan system design condition
Energy recovery device, other than coil runaround loop	$(2.2 \times \text{energy recovery effectiveness}) - 0.5$ inch w.c. for each airstream
Coil runaround loop	0.6 inch w.c. for each airstream
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	0.15 inch w.c.
Exhaust system serving fume hoods	0.35 inch w.c.
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 inch w.c./100 feet of vertical duct exceeding 75 feet
Deductions	
Systems without central cooling device	- 0.6 in. w.c.
Systems without central heating device	- 0.3 in. w.c.
Systems with central electric resistance heat	- 0.2 in. w.c.

For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm.

w.c. = water column, NC = Noise criterion.

C403.2.13 Heating outside a building. Systems installed to provide heat outside a building shall be radiant systems.

Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically deenergized when no occupants are present.

C403.2.14 Refrigeration equipment performance. Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C403.2.14(1) and C403.2.14(2) when tested and rated in accordance with AHRI Standard 1200. The energy use shall be verified through certification under an approved certification program or, where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer.

C403.2.15 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers. Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with this Section. Walk-in coolers and walk-in freezers that are not either site assembled or site constructed shall comply with the following:

1. Be equipped with automatic door-closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.

Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.

2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.
3. Walk-in coolers and refrigerated warehouse coolers shall contain wall, ceiling, and door insulation of not less than R-25 and walk-in freezers and refrigerated warehouse freezers shall contain wall, ceiling and door insulation of not less than R-32.

Exception: Glazed portions of doors or structural members need not be insulated.

4. Walk-in freezers shall contain floor insulation of not less than R-28.
5. Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass.
6. Windows and transparent reach-in doors for walk-in coolers shall be of double-pane or triple-pane, inert gas-filled, heat-reflective treated glass.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct-current motors, or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated

motors, permanent split capacitor-type motors or 3-phase motors.

9. Where antisweat heaters without antisweat heater controls are provided, they shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m²) of door opening for walk-in freezers and 3.0 W/ft² (32 W/m²) of door opening for walk-in coolers.
10. Where antisweat heater controls are provided, they shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Lights in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.

C403.2.16 Walk-in coolers and walk-in freezers. Site-assembled or site-constructed walk-in coolers and walk-in freezers shall comply with the following:

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.

Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.

2. Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.
3. Walls shall be provided with insulation having a thermal resistance of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of walk-in coolers and walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-32.

Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.

4. The floor of walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-28.
5. Transparent reach-in doors for and windows in opaque walk-in freezer doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass.
6. Transparent reach-in doors for and windows in opaque walk-in cooler doors shall be double-pane

TABLE C403.2.14(1)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATION

EQUIPMENT TYPE	APPLICATION	ENERGY USE LIMITS (kWh per day) ^a	TEST PROCEDURE
Refrigerator with solid doors	Holding Temperature	$0.10 \cdot V + 2.04$	AHRI 1200
Refrigerator with transparent doors		$0.12 \cdot V + 3.34$	
Freezers with solid doors		$0.40 \cdot V + 1.38$	
Freezers with transparent doors		$0.75 \cdot V + 4.10$	
Refrigerators/freezers with solid doors		the greater of $0.12 \cdot V + 3.34$ or 0.70	
Commercial refrigerators	Pulldown	$0.126 \cdot V + 3.51$	

a. V = volume of the chiller or frozen compartment as defined in AHAM-HRF-1.

TABLE C403.2.14(2)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATORS AND FREEZERS

EQUIPMENT TYPE				ENERGY USE LIMITS (kWh/day) ^{a,b}	TEST PROCEDURE
Equipment Class ^c	Family Code	Operating Mode	Rating Temperature		
VOP.RC.M	Vertical open	Remote condensing	Medium	$0.82 \cdot TDA + 4.07$	AHRI 1200
SVO.RC.M	Semivertical open	Remote condensing	Medium	$0.83 \cdot TDA + 3.18$	
HZO.RC.M	Horizontal open	Remote condensing	Medium	$0.35 \cdot TDA + 2.88$	
VOP.RC.L	Vertical open	Remote condensing	Low	$2.27 \cdot TDA + 6.85$	
HZO.RC.L	Horizontal open	Remote condensing	Low	$0.57 \cdot TDA + 6.88$	
VCT.RC.M	Vertical transparent door	Remote condensing	Medium	$0.22 \cdot TDA + 1.95$	
VCT.RC.L	Vertical transparent door	Remote condensing	Low	$0.56 \cdot TDA + 2.61$	
SOC.RC.M	Service over counter	Remote condensing	Medium	$0.51 \cdot TDA + 0.11$	
VOP.SC.M	Vertical open	Self-contained	Medium	$1.74 \cdot TDA + 4.71$	
SVO.SC.M	Semivertical open	Self-contained	Medium	$1.73 \cdot TDA + 4.59$	
HZO.SC.M	Horizontal open	Self-contained	Medium	$0.77 \cdot TDA + 5.55$	
HZO.SC.L	Horizontal open	Self-contained	Low	$1.92 \cdot TDA + 7.08$	
VCT.SC.I	Vertical transparent door	Self-contained	Ice cream	$0.67 \cdot TDA + 3.29$	
VCS.SC.I	Vertical solid door	Self-contained	Ice cream	$0.38 \cdot V + 0.88$	
HCT.SC.I	Horizontal transparent door	Self-contained	Ice cream	$0.56 \cdot TDA + 0.43$	
SVO.RC.L	Semivertical open	Remote condensing	Low	$2.27 \cdot TDA + 6.85$	
VOP.RC.I	Vertical open	Remote condensing	Ice cream	$2.89 \cdot TDA + 8.7$	
SVO.RC.I	Semivertical open	Remote condensing	Ice cream	$2.89 \cdot TDA + 8.7$	
HZO.RC.I	Horizontal open	Remote condensing	Ice cream	$0.72 \cdot TDA + 8.74$	
VCT.RC.I	Vertical transparent door	Remote condensing	Ice cream	$0.66 \cdot TDA + 3.05$	
HCT.RC.M	Horizontal transparent door	Remote condensing	Medium	$0.16 \cdot TDA + 0.13$	

(continued)

TABLE C403.2.14(2)—continued
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATORS AND FREEZERS

EQUIPMENT TYPE				ENERGY USE LIMITS (kWh/day) ^{a,b}	TEST PROCEDURE
Equipment Class ^c	Family Code	Operating Mode	Rating Temperature		
HCT.RC.L	Horizontal transparent door	Remote condensing	Low	$0.34 \cdot TDA + 0.26$	AHRI 1200
HCT.RC.I	Horizontal transparent door	Remote condensing	Ice cream	$0.4 \cdot TDA + 0.31$	
VCS.RC.M	Vertical solid door	Remote condensing	Medium	$0.11 \cdot V + 0.26$	
VCS.RC.L	Vertical solid door	Remote condensing	Low	$0.23 \cdot V + 0.54$	
VCS.RC.I	Vertical solid door	Remote condensing	Ice cream	$0.27 \cdot V + 0.63$	
HCS.RC.M	Horizontal solid door	Remote condensing	Medium	$0.11 \cdot V + 0.26$	
HCS.RC.L	Horizontal solid door	Remote condensing	Low	$0.23 \cdot V + 0.54$	
HCS.RC.I	Horizontal solid door	Remote condensing	Ice cream	$0.27 \cdot V + 0.63$	
HCS.RC.I	Horizontal solid door	Remote condensing	Ice cream	$0.27 \cdot V + 0.63$	
SOC.RC.L	Service over counter	Remote condensing	Low	$1.08 \cdot TDA + 0.22$	
SOC.RC.I	Service over counter	Remote condensing	Ice cream	$1.26 \cdot TDA + 0.26$	
VOP.SC.L	Vertical open	Self-contained	Low	$4.37 \cdot TDA + 11.82$	
VOP.SC.I	Vertical open	Self-contained	Ice cream	$5.55 \cdot TDA + 15.02$	
SVO.SC.L	Semivertical open	Self-contained	Low	$4.34 \cdot TDA + 11.51$	
SVO.SC.I	Semivertical open	Self-contained	Ice cream	$5.52 \cdot TDA + 14.63$	
HZO.SC.I	Horizontal open	Self-contained	Ice cream	$2.44 \cdot TDA + 9.0$	
SOC.SC.I	Service over counter	Self-contained	Ice cream	$1.76 \cdot TDA + 0.36$	
HCS.SC.I	Horizontal solid door	Self-contained	Ice cream	$0.38 \cdot V + 0.88$	

a. V = Volume of the case, as measured in accordance with Appendix C of AHRI 1200.

b. TDA = Total display area of the case, as measured in accordance with Appendix D of AHRI 1200.

c. Equipment class designations consist of a combination [(in sequential order separated by periods (AAA).(BB).(C))]:

(AAA) An equipment family code where:

VOP = vertical open

SVO = semivertical open

HZO = horizontal open

VCT = vertical transparent doors

VCS = vertical solid doors

HCT = horizontal transparent doors

HCS = horizontal solid doors

SOC = service over counter

(BB) An operating mode code:

RC = remote condensing

SC = self-contained

(C) A rating temperature code:

M = medium temperature (38°F)

L = low temperature (0°F)

I = ice-cream temperature (15°F)

For example, “VOP.RC.M” refers to the “vertical-open, remote-condensing, medium-temperature” equipment class.

heat-reflective treated glass having the interstitial space gas filled.

7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor-type or shall be 3-phase motors.

Exception: Fan motors in walk-in coolers and walk-in freezers combined in a single enclosure greater than 3,000 square feet (279 m²) in floor area are exempt.

9. Antisweat heaters that are not provided with antisweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft² (76 W/m²) of door opening for walk-in freezers, and not greater than 3.0 W/ft² (32 W/m²) of door opening for walk-in coolers.
10. Antisweat heater controls shall be capable of reducing the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer was last occupied.

C403.2.17 Refrigerated display cases. Site-assembled or site-constructed refrigerated display cases shall comply with the following:

1. Lighting and glass doors in refrigerated display cases shall be controlled by one of the following:
 - 1.1. Time switch controls to turn off lights during nonbusiness hours. Timed overrides for display cases shall turn the lights on for up to 1 hour and shall automatically time out to turn the lights off.
 - 1.2. Motion sensor controls on each display case section that reduce lighting power by at least 50 percent within 3 minutes after the area within the sensor range is vacated.
2. Low-temperature display cases shall incorporate temperature-based defrost termination control with a time-limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.
3. Antisweat heater controls shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.

C403.3 Economizers (Prescriptive). Each cooling system shall include either an air or water economizer complying with Subsections C403.3.1 through C403.3.4.

Exceptions: Economizers are not required for the systems listed below.

1. In cooling systems for buildings located in Climate Zones 1A and 1B.
2. In climate zones other than 1A and 1B, where individual fan cooling units have a capacity of less than 54,000 Btu/h (15.8 kW) and meet one of the following:
 - 2.1. Have direct expansion cooling coils.
 - 2.2. The total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).

The total supply capacity of all fan-cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan-cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.

3. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
4. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table C403.3(1).
5. Systems expected to operate less than 20 hours per week.
6. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
7. The required air or water economizer may be eliminated if the minimum code required cooling efficiency of the HVAC unit rated with an IPLV, IEER or SEER is increased by at least 17 percent. If the HVAC unit is only rated with a full-load metric like EER cooling, then it must be increased by at least 17 percent.
8. Chilled-water cooling systems that are passive (without a fan) or use induction where the total chilled water system capacity less the capacity of fan units with air economizers is less than the minimum specified in Table C403.3(1).
9. Systems that include a heat recovery system in accordance with Subsection C403.4.5.

Table C403.3(2) Equipment Efficiency Performance Exception for Economizers. Reserved.

C403.3.1 Integrated economizer control. Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even where additional mechanical cooling is required to provide the remainder of the cooling load. Controls shall not be

TABLE C403.3(1)
MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR DETERMINING ECONOMIZER COOLING REQUIREMENTS

CLIMATE ZONES (COOLING)	TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS	
	Local Water-cooled Chilled-water Systems	Air-cooled Chilled-water Systems or District Chilled-Water Systems
1a	No economizer requirement	No economizer requirement
1b, 2a, 2b	960,000 Btu/h	1,250,000 Btu/h
3a, 3b, 3c, 4a, 4b, 4c	720,000 Btu/h	940,000 Btu/h
5a, 5b, 5c, 6a, 6b, 7, 8	1,320,000 Btu/h	1,720,000 Btu/h

For SI: 1 British thermal unit per hour = 0.2931 W.

capable of creating a false load in the mechanical cooling systems by limiting or disabling the economizer or any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling.

Units that include an air economizer shall comply with the following:

1. Unit controls shall have the mechanical cooling capacity control interlocked with the air economizer controls such that the outdoor air damper is at the 100-percent open position when mechanical cooling is on and the outdoor air damper does not begin to close to prevent coil freezing due to minimum compressor run time until the leaving air temperature is less than 45°F (7°C).
2. Direct expansion (DX) units that control 75,000 Btu/h (22 kW) or greater of rated capacity of the capacity of the mechanical cooling directly based on occupied space temperature shall have not fewer than two stages of mechanical cooling capacity.
3. Other DX units, including those that control space temperature by modulating the airflow to the space, shall be in accordance with Table C403.3.1.

C403.3.2 Economizer heating system impact. HVAC system design and economizer controls shall be such that economizer operation does not increase building heating energy use during normal operation.

Exception: Economizers on variable air volume (VAV) systems that cause zone level heating to increase due to a reduction in supply air temperature.

C403.3.3 Air economizers. Air economizers shall comply with Subsections C403.3.3.1 through C403.3.3.5.

C403.3.3.1 Design capacity. Air economizer systems shall be capable of modulating outdoor air and return air dampers to provide up to 100 percent of the design supply air quantity as outdoor air for cooling.

C403.3.3.2 Control signal. Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed-air temperature.

Exception: The use of mixed-air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).

C403.3.3.3 High-limit shutoff. Air economizers shall be capable of automatically reducing outdoor air intake to the design minimum outdoor air quantity when outdoor air intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table C403.3.3.3. High-limit shutoff control settings for these control types shall be those specified in Table C403.3.3.3.

C403.3.3.4 Relief of excess outdoor air. Systems shall be capable of relieving excess outdoor air during air economizer operation to prevent overpressurizing the building. The relief air outlet shall be located to avoid recirculation into the building.

C403.3.3.5 Economizer dampers. Return, exhaust/relief and outdoor air dampers used in economizers shall comply with Subsection C403.2.4.3.

C403.3.4 Water-side economizers. Water-side economizers shall comply with Subsections C403.3.4.1 and C403.3.4.2.

C403.3.4.1 Design capacity. Water economizer systems shall be capable of cooling supply air by indirect evaporation and providing up to 100 percent of the expected system cooling load at outdoor air temperatures of not greater than 50°F (10°C) dry bulb/45°F (7°C) wet bulb.

Exceptions:

1. Systems primarily serving computer rooms in which 100 percent of the expected system cooling load at 40°F (4°C) dry bulb/35°F (1.7°C) wet bulb is met with evaporative water economizers.
2. Systems primarily serving computer rooms with dry cooler water economizers which satisfy 100 percent of the expected system cooling load at 35°F (1.7°C) dry bulb.
3. Systems where dehumidification requirements cannot be met using outdoor air temperatures of 50°F (10°C) dry bulb/45°F (7°C) wet bulb

TABLE C403.3.1
DX COOLING STAGE REQUIREMENTS FOR MODULATING AIRFLOW UNITS

RATING CAPACITY	MINIMUM NUMBER OF MECHANICAL COOLING STAGES	MINIMUM COMPRESSOR DISPLACEMENT ^a
≥ 65,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% of full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

For SI: 1 British thermal unit per hour = 0.2931 W.

a. For mechanical cooling stage control that does not use variable compressor displacement, the percent displacement shall be equivalent to the mechanical cooling capacity reduction evaluated at the full load rating conditions for the compressor.

TABLE C403.3.3.3
HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERS^b

DEVICE TYPE	CLIMATE ZONE	REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):	
		Equation	Description
Fixed dry bulb	1B, 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, 8	$T_{OA} > 75^{\circ}\text{F}$	Outdoor air temperature exceeds 75°F
	5A, 6A	$T_{OA} > 70^{\circ}\text{F}$	Outdoor air temperature exceeds 70°F
	1A, 2A, 3A, 4A	$T_{OA} > 65^{\circ}\text{F}$	Outdoor air temperature exceeds 65°F
Differential dry bulb	1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	$T_{OA} > T_{RA}$	Outdoor air temperature exceeds return air temperature
Fixed enthalpy with fixed dry-bulb temperatures	All	$h_{OA} > 28 \text{ Btu/lb}^a$ or $T_{OA} > 75^{\circ}\text{F}$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air ^a or Outdoor air temperature exceeds 75°F
Differential enthalpy with fixed dry-bulb temperature	All	$h_{OA} > h_{RA}$ or $T_{OA} > 75^{\circ}\text{F}$	Outdoor air enthalpy exceeds return air enthalpy or Outdoor air temperature exceeds 75°F

For SI: 1 foot = 305 mm, °C = (°F - 32)/1.8, 1 Btu/lb = 2.33 kJ/kg.

a. At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 75°F and 50-percent relative humidity. As an example, at approximately 6,000 feet elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

b. Devices with selectable setpoints shall be capable of being set to within 2°F and 2 Btu/lb of the setpoint listed.

and where 100 percent of the expected system cooling load at 45°F (7°C) dry bulb/40°F (4°C) wet bulb is met with evaporative water economizers.

C403.3.4.2 Maximum pressure drop. Precooling coils and water-to-water heat exchangers used as part of a water economizer system shall either have a water-side pressure drop of less than 15 feet (45 kPa) of water or a secondary loop shall be created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in the normal cooling (noneconomizer) mode.

C403.4 Hydronic and multiple-zone HVAC systems controls and equipment. (Prescriptive). Hydronic and multiple-zone HVAC system controls and equipment shall comply with this Section.

C403.4.1 Fan control. Controls shall be provided for fans in accordance with Subsections C403.4.1.1 through C403.4.1.3.

C403.4.1.1 Fan airflow control. Each cooling system listed in Table C403.4.1.1 shall be designed to vary the

indoor fan airflow as a function of load and shall comply with the following requirements:

1. Direct expansion (DX) and chilled water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have not fewer than two stages of fan control. Low or minimum speed shall not be greater than 66 percent of full speed. At low or minimum speed, the fan system shall draw not more than 40 percent of the fan power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.
2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed the fan system shall draw not more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during

periods of low cooling load and ventilation-only operation.

- Units that include an airside economizer in accordance with Subsection C403.3 shall have not fewer than two speeds of fan control during economizer operation.

Exceptions:

- Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide ventilation air and the indoor fan cycles with the load.
- Where the volume of outdoor air required to comply with the ventilation requirements of the *EPCOT Mechanical Code* at low speed exceeds the air that would be delivered at the speed defined in Subsection C403.4.1, the minimum speed shall be selected to provide the required ventilation air.

**TABLE C403.4.1.1
EFFECTIVE DATES FOR FAN CONTROL**

COOLING SYSTEM TYPE	FAN MOTOR SIZE	MECHANICAL COOLING CAPACITY
DX cooling	Any	≥ 75,000 Btu/h (before 1/1/2016)
		≥ 65,000 Btu/h (after 1/1/2016)
Chilled water and evaporative cooling	≥ 5 hp	Any
	≥ 1/4 hp	Any

For SI: 1 British thermal unit per hour = 0.2931 W; 1 hp = 0.746 kW.

C403.4.1.2 Static pressure sensor location. Static pressure sensors used to control VAV fans shall be located such that the controller set point is not greater than 1.2 inches w.c. (299 Pa). Where this results in one or more sensors being located downstream of major duct splits, not less than one sensor shall be located on each major branch to ensure that static pressure can be maintained in each branch.

C403.4.1.3 Set points for direct digital control. For systems with direct digital control of individual zones reporting to the central control panel, the static pressure set point shall be reset based on the zone requiring the most pressure. In such case, the set point is reset lower until one zone damper is nearly wide open. The direct digital controls shall be capable of monitoring zone damper positions or shall have an alternative method of indicating the need for static pressure that is capable of all of the following:

- Automatically detecting any zone that excessively drives the reset logic.
- Generating an alarm to the system operational location.
- Allowing an operator to readily remove one or more zones from the reset algorithm.

C403.4.2 Hydronic systems controls. The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Subsections C403.4.2.1 through C403.4.2.3. Hydronic heating systems comprised of multiple-packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers. Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h (146.5 kW) input design capacity shall include either a multistaged or modulating burner.

C403.4.2.1 Three-pipe system. Hydronic systems that use a common return system for both hot water and chilled water are prohibited.

C403.4.2.2 Two-pipe changeover system. Systems that use a common distribution system to supply both heated and chilled water shall be designed to allow a dead band between changeover from one mode to the other of not less than 15°F (8.3°C) outside air temperatures; be designed to and provided with controls that will allow operation in one mode for not less than 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the changeover point to be not more than 30°F (16.7°C) apart.

C403.4.2.3 Hydronic (water loop) heat pump systems. Hydronic heat pump systems shall comply with Subsections C403.4.2.3.1 through C403.4.2.3.2.

C403.4.2.3.1 Temperature dead band. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of not less than 20°F (11°C) between initiation of heat rejection and heat addition by the central devices.

Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on realtime conditions of demand and capacity, dead bands of less than 20°F (11°C) shall be permitted.

C403.4.2.3.2 Heat rejection. Heat rejection equipment shall comply with Subsections C403.4.2.3.2.1 and C403.4.2.3.2.2.

Exception: Where it can be demonstrated that a heat pump system will be required to reject heat throughout the year.

C403.4.2.3.2.1 Climate Zones 3 and 4. For Climate Zones 3 and 4:

- Where a closed-circuit cooling tower is used directly in the heat pump loop, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or lower leakage positive closure dampers shall be provided.

2. Where an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower.
3. Where an open- or closed-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.

C403.4.2.3.2.2 Climate Zones 5 through 8. For Climate Zones 5 through 8, where an open- or closed-circuit cooling tower is used, a separate heat exchanger shall be provided to isolate the cooling tower from the heat pump loop, and heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop and providing an automatic valve to stop the flow of fluid.

C403.4.2.3.3 Two-position valve. Each hydronic heat pump on the hydronic system having a total pump system power exceeding 10 hp (7.5 kW) shall have a two-position valve.

C403.4.2.4 Part-load controls. Hydronic systems greater than or equal to 500,000 Btu/h (146.5 kW) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to do all of the following:

1. Automatically reset the supply-water temperatures in response to varying building heating and cooling demand using coil valve position, zone-return water temperature, building-return water temperature or outside air temperature. The temperature shall be capable of being reset by not less than 25 percent of the design supply-to-return water temperature difference.
2. Automatically vary fluid flow for hydronic systems with a combined motor capacity of 10 hp (7.5 kW) or larger with three or more control valves or other devices by reducing the system design flow rate by not less than 50 percent by designed valves that modulate or step open and close, or pumps that modulate or turn on and off as a function of load.
3. Automatically vary pump flow on chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners with a combined motor capacity of 10 hp (7.5 kW) or larger by reducing pump design flow by not less than 50 percent, utilizing adjustable speed drives on pumps, or multiple-staged pumps where not less than one-half of the total pump horsepower is capable of being automatically turned off. Pump flow shall be controlled to maintain one control

valve nearly wide open or to satisfy the minimum differential pressure.

Exceptions:

1. Supply-water temperature reset for chilled-water systems supplied by off-site district chilled water or chilled water from ice storage systems.
2. Minimum flow rates other than 50 percent as required by the equipment manufacturer for proper operation of equipment where using flow bypass or end-of-line 3-way valves.
3. Variable pump flow on dedicated equipment circulation pumps where configured in primary/secondary design to provide the minimum flow requirements of the equipment manufacturer for proper operation of equipment.

C403.4.2.5 Boiler turndown. Boiler systems with design input of greater than 1,000,000 Btu/h (293 kW) shall comply with the turndown ratio specified in Table C403.4.2.5.

The system turndown requirement shall be met through the use of multiple single input boilers, one or more modulating boilers or a combination of single input and modulating boilers.

C403.4.2.6 Pump isolation. Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller.

Boiler plants including more than one boiler shall have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.

**TABLE C403.4.2.5
BOILER TURNDOWN**

BOILER SYSTEM DESIGN INPUT (Btu/h)	MINIMUM TURNDOWN RATIO
≥ 1,000,000 and less than or equal to 5,000,000	3 to 1
> 5,000,000 and less than or equal to 10,000,000	4 to 1
> 10,000,000	5 to 1

For SI: 1 British thermal unit per hour = 0.2931 W.

C403.4.3 Heat rejection equipment. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception: Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables C403.2.3(6) and C403.2.3(7).

C403.4.3.1 General. Heat rejection equipment such as air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative

condensers used for comfort cooling applications shall comply with this Section.

Exception: Heat rejection devices where energy usage is included in the equipment efficiency ratings listed in Tables C403.2.3(6) and C403.2.3(7).

C403.4.3.2 Fan speed control. The fan speed shall be controlled as provided in Subsections C403.4.3.2.1 and C403.4.3.2.2.

C403.4.3.2.1 Fan motors not less than 7.5 hp. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception: The following fan motors over 7.5 hp (5.6 kW) are exempt:

1. Condenser fans serving multiple refrigerant circuits.
2. Condenser fans serving flooded condensers.
3. Installations located in Climate Zones 1 and 2.

C403.4.3.2.2 Multiple-cell heat rejection equipment. Multiple-cell heat rejection equipment with variable speed fan drives shall be controlled in both of the following manners:

1. To operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components.
2. So all fans can operate at the same fan speed required for the instantaneous cooling duty, as opposed to staged (on/off) operation.

Minimum fan speed shall be the minimum allowable speed of the fan drive system in accordance with the manufacturer's recommendations.

C403.4.3.3 Limitation on centrifugal fan open-circuit cooling towers. Centrifugal fan open-circuit cooling towers with a combined rated capacity of 1,100 gpm (4164 L/m) or greater at 95°F (35°C) condenser water return, 85°F (29°C) condenser water supply, and 75°F (24°C) outdoor air wet-bulb temperature shall meet the energy efficiency requirement for axial fan open-circuit cooling towers listed in Table C403.2.3(8).

Exception: Centrifugal open-circuit cooling towers that are designed with inlet or discharge ducts or require external sound attenuation.

C403.4.3.4 Tower flow turndown. Open-circuit cooling towers used on water-cooled chiller systems that are configured with multiple- or variable-speed condenser water pumps shall be designed so that all open-circuit cooling tower cells can be run in parallel with the larger of the flow that is produced by the smallest pump at its minimum expected flow rate or at 50 percent of the design flow for the cell.

C403.4.4 Requirements for complex mechanical systems serving multiple zones. Subsections C403.4.4.1 through C403.4.6.4 shall apply to complex mechanical systems serving multiple zones. Supply air systems serving multiple zones shall be variable air volume (VAV) systems that, during periods of occupancy, are designed and capable of being controlled to reduce primary air supply to each zone to one of the following before reheating, recooling or mixing takes place:

1. Thirty percent of the maximum supply air to each zone.
2. Three hundred cfm (142 L/s) or less where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate.
3. The minimum ventilation requirements of the *EPCOT Mechanical Code*.
4. Any higher rate that can be demonstrated to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system, as approved by the Building Official.
5. The airflow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.

Exception: The following individual zones or entire air distribution systems are exempted from the requirement for VAV control:

1. Zones or supply air systems where not less than 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source.
2. Zones where special humidity levels are required to satisfy process needs.
3. Zones with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate.
4. Zones where the volume of air to be reheated, recooled or mixed is not greater than the volume of outside air required to provide the minimum ventilation requirements of the *EPCOT Mechanical Code*.
5. Zones or supply air systems with thermostatic and humidistatic controls capable of operating in sequence the supply of heating and cooling energy to the zones and which are capable of preventing reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either mechanically or through the use of economizer systems, and air that has been previously mechanically heated.

C403.4.4.1 Single-duct VAV systems, terminal devices. Single-duct VAV systems shall use terminal devices capable of reducing the supply of primary supply air before reheating or recooling takes place.

C403.4.4.2 Dual-duct and mixing VAV systems, terminal devices. Systems that have one warm air duct and

one cool air duct shall use terminal devices that are capable of reducing the flow from one duct to a minimum before mixing of air from the other duct takes place.

C403.4.4.3 Single-fan dual-duct and mixing VAV systems, economizers. Individual dual-duct or mixing heating and cooling systems with a single fan and with total capacities greater than 90,000 Btu/h [(26.4 kW) 7.5 tons] shall not be equipped with air economizers.

C403.4.4.4 Fractional hp fan motors. Motors for fans that are not less than $\frac{1}{12}$ hp (0.082 kW) and less than 1 hp (0.746 kW) shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent, rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. The use of belt-driven fans to sheave adjustments for airflow balancing instead of a varying motor speed shall be permitted.

Exceptions: The following motors are not required to comply with this Section:

1. Motors in the airstream within fan coils and terminal units that only provide heating to the space served.
2. Motors in space-conditioning equipment that comply with Subsection 403.2.3 or C403.2.12.
3. Motors that comply with Subsection C405.8.

C403.4.4.5 Supply-air temperature reset controls. Multiple-zone HVAC systems shall include controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be capable of resetting the supply air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room air temperature.

Exceptions:

1. Systems that prevent reheating, recooling or mixing of heated and cooled supply air.
2. Seventy-five percent of the energy for reheating is from site-recovered or site-solar energy sources.
3. Zones with peak supply air quantities of 300 cfm (142 L/s) or less.

C403.4.4.6 Multiple-zone VAV system ventilation optimization control. Multiple-zone VAV systems with direct digital control of individual zone boxes reporting to a central control panel shall have automatic controls configured to reduce outdoor air intake flow below design rates in response to changes in system ventilation efficiency (E_v) as defined by the *EPCOT Mechanical Code*.

Exceptions:

1. VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV

systems, and VAV systems with fan-powered terminal units.

2. Systems having exhaust air energy recovery complying with Subsection C403.2.7.
3. Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements.

C403.4.5 Heat recovery for service water heating. Condenser heat recovery shall be installed for heating or reheating of service hot water provided that the facility operates 24 hours a day, the total installed heat capacity of water-cooled systems exceeds 6,000,000 Btu/hr (1 758 kW) of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h (293 kW).

The required heat recovery system shall have the capacity to provide the smaller of the following:

1. Sixty percent of the peak heat rejection load at design conditions.
2. The preheating required to raise the peak service hot water draw to 85°F (29°C).

Exceptions:

1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.

C403.4.6 Hot gas bypass limitation. Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited as indicated in Table C403.4.6, as limited by Subsection C403.3.1.

**TABLE C403.4.6
MAXIMUM HOT GAS BYPASS CAPACITY**

RATED CAPACITY	MAXIMUM HOT GAS BYPASS CAPACITY (% of total capacity)
≤ 240,000 Btu/h	50
> 240,000 Btu/h	25

For SI: 1 British thermal unit per hour = 0.2931 W.

C403.5 Refrigeration systems. Refrigerated display cases, walk-in coolers or walk-in freezers that are served by remote compressors and remote condensers not located in a condensing unit, shall comply with Subsections C403.5.1 and C403.5.2.

Exception: Systems where the working fluid in the refrigeration cycle goes through both subcritical and supercritical states (transcritical) or that use ammonia refrigerant are exempt.

C403.5.1 Condensers serving refrigeration systems. Fan-powered condensers shall comply with the following:

1. The design saturated condensing temperatures for air-cooled condensers shall not exceed the design dry-bulb temperature plus 10°F (5.6°C) for low-temperature refrigeration systems, and the design dry-bulb temperature plus 15°F (8°C) for medium temperature refrigeration systems where the saturated condensing temperature for blend refrigerants shall be determined using the average of liquid and vapor temperatures as converted from the condenser drain pressure.
2. Condenser fan motors that are less than 1 hp (0.75 kW) shall use electronically commutated motors, permanent split-capacitor-type motors or 3-phase motors.
3. Condenser fans for air-cooled condensers, evaporatively cooled condensers, air- or water-cooled fluid coolers or cooling towers shall reduce fan motor demand to not more than 30 percent of design wattage at 50 percent of design air volume, and incorporate one of the following continuous variable speed fan control approaches:
 - 3.1. Refrigeration system condenser control for air-cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient dry-bulb temperature.
 - 3.2. Refrigeration system condenser control for evaporatively cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient wet-bulb temperature.
4. Multiple fan condensers shall be controlled in unison.
5. The minimum condensing temperature setpoint shall be not greater than 70°F (21°C).

C403.5.2 Compressor systems. Refrigeration compressor systems shall comply with the following:

1. Compressors and multiple-compressor system suction groups shall include control systems that use floating suction pressure control logic to reset the target suction pressure temperature based on the temperature requirements of the attached refrigeration display cases or walk-ins.

Exception: Controls are not required for the following:

1. Single-compressor systems that do not have variable capacity capability.
2. Suction groups that have a design saturated suction temperature of 30°F (-1.1°C) or higher, suction groups that comprise the high stage of a two-stage or cascade system, or suction groups that primarily serve chillers for secondary cooling fluids.

2. Liquid subcooling shall be provided for all low-temperature compressor systems with a design cooling capacity equal to or greater than 100,000 Btu/hr (29.3 kW) with a design-saturated suction temperature of -10°F (-23°C) or lower. The sub-cooled liquid temperature shall be controlled at a maximum temperature setpoint of 50°F (10°C) at the exit of the sub-cooler using either compressor economizer (interstage) ports or a separate compressor suction group operating at a saturated suction temperature of 18°F (-7.8°C) or higher.

- 2.1. Insulation for liquid lines with a fluid operating temperature less than 60°F (15.6°C) shall comply with Table C403.2.10.

3. Compressors that incorporate internal or external crankcase heaters shall provide a means to cycle the heaters off during compressor operation.

C403.5.3 Condensing coils installed in cool air stream of another air-conditioning unit. The condensing coil of one air-conditioning unit shall not be installed in the cool air stream of another air-conditioning unit.

Exceptions:

1. Where condenser heat reclaim is used in a properly designed system including enthalpy control devices to achieve requisite humidity control for process, special storage or equipment spaces and occupant comfort within the criteria of ASHRAE Standard 55. Such systems shall result in less energy use than other appropriate options.
2. For computer or clean rooms whose location precludes the use of systems that would not reject heat into conditioned spaces.

SECTION C404

SERVICE WATER HEATING (MANDATORY)

C404.1 General. This Section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.

C404.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table C404.2. The efficiency shall be verified through data furnished by the manufacturer of the equipment or through certification under an approved certification program. Water-heating equipment also intended to be used to provide space heating shall meet the applicable provisions of Table C404.2.

C404.2.1 High input-rated service water-heating systems. Gas-fired water-heating equipment installed in new buildings shall be in compliance with this Section. Where a singular piece of water-heating equipment serves the entire building and the input rating of the equipment is 1,000,000 Btu/h (293 kW) or greater, such equipment shall have a thermal efficiency, E_t , of not less than 90 percent. Where multiple pieces of water-heating equipment serve the building and the combined input rat-

ing of the water-heating equipment is 1,000,000 Btu/h (293 kW) or greater, the combined input-capacity-weighted-average thermal efficiency, E_p , shall be not less than 90 percent.

Exceptions:

1. Where 25 percent of the annual service water-heating requirement is provided by site-solar or site-recovered energy, the minimum thermal efficiency requirements of this Section shall not apply.
2. The input rating of water heaters installed in individual dwelling units shall not be required to be included in the total input rating of service water-heating equipment for a building.
3. The input rating of water heaters with an input rating of not greater than 100,000 Btu/h (29.3 kW) shall not be required to be included in the total input rating of service water-heating equipment for a building.

C404.3 Heat traps. Water-heating equipment not supplied with integral heat traps and serving noncirculating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

C404.4 Insulation of piping. Piping from a water heater to the termination of the heated water fixture supply pipe shall be insulated in accordance with Table C403.2.10. On both the inlet and outlet piping of a storage water heater or heated water storage tank, the piping to a heat trap or the first 8 feet (2438 mm) of piping, whichever is less, shall be insulated. Piping that is heat traced shall be insulated in accordance with Table C403.2.10 or the heat trace manufacturer's instructions. Tubular pipe insulation shall be installed in accordance with the insulation manufacturer's instructions. Pipe insulation shall be continuous except where the piping passes through a framing member. The minimum insulation thickness requirements of this Section shall not supersede any greater insulation thickness requirements necessary for the protection of piping from freezing temperatures or the protection of personnel against external surface temperatures on the insulation.

Exception: Tubular pipe insulation shall not be required on the following:

1. The tubing from the connection at the termination of the fixture supply piping to a plumbing fixture or plumbing appliance.
2. Valves, pumps, strainers and threaded unions in piping that is 1 inch (25 mm) or less in nominal diameter.
3. Piping from user-controlled shower and bath mixing valves to the water outlets.
4. Cold-water piping of a demand recirculation water system.
5. Tubing from a hot drinking-water heating unit to the water outlet.
6. Piping at locations where a vertical support of the piping is installed.

7. Piping surrounded by building insulation with a thermal resistance (R -value) of not less than $R-3$.

C404.5 Efficient heated water supply piping. Heated water supply piping shall be in accordance with Subsection C404.5.1 or C404.5.2. The flow rate through $\frac{1}{4}$ -inch (6.4 mm) piping shall be not greater than 0.5 gpm (1.9 L/m). The flow rate through $\frac{5}{16}$ -inch (7.9 mm) piping shall be not greater than 1 gpm (3.8 L/m). The flow rate through $\frac{3}{8}$ -inch (9.5 mm) piping shall be not greater than 1.5 gpm (5.7 L/m).

C404.5.1 Maximum allowable pipe length method. The maximum allowable piping length from the nearest source of heated water to the termination of the fixture supply pipe shall be in accordance with the following. Where the piping contains more than one size of pipe, the largest size of pipe within the piping shall be used for determining the maximum allowable length of the piping in Table C404.5.1.

1. For a public lavatory faucet, use the "Public lavatory faucets" column in Table C404.5.1.
2. For all other plumbing fixtures and plumbing appliances, use the "Other fixtures and appliances" column in Table C404.5.1.

C404.5.2 Maximum allowable pipe volume method. The water volume in the piping shall be calculated in accordance with Subsection C404.5.2.1. Water heaters, circulating water systems and heat trace temperature maintenance systems shall be considered sources of heated water.

The volume from the nearest source of heated water to the termination of the fixture supply pipe shall be as follows:

1. For a public lavatory faucet: not more than 2 ounces (0.06 L).
2. For other plumbing fixtures or plumbing appliances: not more than 0.5 gallon (1.89 L).

C404.5.2.1 Water volume determination. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from the "Volume" column in Table C404.5.1. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

C404.6 Heated-water circulating and temperature maintenance systems. Heated-water circulation systems shall be in accordance with Subsection C404.6.1. Heat trace temperature maintenance systems shall be in accordance with Subsection C404.6.2. Controls for hot water storage shall be in accordance with Subsection C404.6.3. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

TABLE C404.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED ^{a, b}	TEST PROCEDURE
Water heaters, electric	≤ 12 kW ^d	Resistance	0.97 - 0.00 132V, EF	DOE 10 CFR Part 430
	> 12 kW	Resistance	(0.3 + 27/V _m), %/h	ANSI Z21.10.3
	≤ 24 amps and ≤ 250 volts	Heat pump	0.93 - 0.00 132V, EF	DOE 10 CFR Part 430
Storage water heaters, gas	≤ 75,000 Btu/h	≥ 20 gal	0.67 - 0.0019V, EF	DOE 10 CFR Part 430
	> 75,000 Btu/h and ≤ 155,000 Btu/h	< 4,000 Btu/h/gal	80% E _t (Q/800 + 110.√V)SL, Btu/h	ANSI Z21.10.3
	> 155,000 Btu/h	< 4,000 Btu/h/gal	80% E _t (Q/800 + 110.√V)SL, Btu/h	
Instantaneous water heaters, gas	> 50,000 Btu/h and < 200,000 Btu/h ^c	≥ 4,000 (Btu/h)/gal and < 2 gal	0.62 - 0.00 19V, EF	DOE 10 CFR Part 430
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E _t	ANSI Z21.10.3
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E _t (Q/800 + 110.√V)SL, Btu/h	
Storage water heaters, oil	≤ 105,000 Btu/h	≥ 20 gal	0.59 - 0.0019V, EF	DOE 10 CFR Part 430
	≥ 105,000 Btu/h	< 4,000 Btu/h/gal	80% E _t (Q/800 + 110.√V)SL, Btu/h	ANSI Z21.10.3
Instantaneous water heaters, oil	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 2 gal	0.59 - 0.0019V, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E _t	ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	78% E _t (Q/800 + 110.√V)SL, Btu/h	
Hot water supply boilers, gas and oil	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E _t	ANSI Z21.10.3
Hot water supply boilers, gas	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E _t (Q/800 + 110.√V)SL, Btu/h	
Hot water supply boilers, oil	> 300,000 Btu/h and < 12,500,000 Btu/h	> 4,000 Btu/h/gal and > 10 gal	78% E _t (Q/800 + 110.√V)SL, Btu/h	
Pool heaters, gas and oil	All	—	82% E _t	ASHRAE 146
Heat pump pool heaters	All	—	4.0 COP At low air temperature	AHRI 1160 ^{e, f}
Unfired storage tanks	All	—	Minimum insulation requirement R-12.5 (h · ft ² · °F)/Btu	(none)

For SI: °C = [(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

- Energy factor (EF) and thermal efficiency (E_t) are minimum requirements. In the EF equation, V is the rated volume in gallons.
- Standby loss (SL) is the maximum Btu/h based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, Q is the nameplate input rate in Btu/h. In the equations for electric water heaters, V is the rated volume in gallons and V_m is the measured volume in gallons. In the SL equation for oil and gas water heaters and boilers, V is the rated volume in gallons.
- Instantaneous water heaters with input rates below 200,000 Btu/h shall comply with these requirements where the water heater is designed to heat water to temperatures 180°F or higher.
- Electric water heaters with an input rating of 12 kW (40,950 Btu/hr) or less that are designed to heat water to temperatures of 180°F or greater shall comply with the requirements for electric water heaters that have an input rating greater than 12 kW (40,950 Btu/h).
- Test report from independent laboratory is required to verify procedure compliance.
- Geothermal swimming pool heat pumps are not required to meet this standard.

TABLE C404.5.1
PIPING VOLUME AND MAXIMUM PIPING LENGTHS

NOMINAL PIPE SIZE (inches)	VOLUME (liquid ounces per foot length)	MAXIMUM PIPING LENGTH (feet)	
		Public lavatory faucets	Other fixtures and appliances
$\frac{1}{4}$	0.33	6	50
$\frac{5}{16}$	0.5	4	50
$\frac{3}{8}$	0.75	3	50
$\frac{1}{2}$	1.5	2	43
$\frac{5}{8}$	2	1	32
$\frac{3}{4}$	3	0.5	21
$\frac{7}{8}$	4	0.5	16
1	5	0.5	13
$1\frac{1}{4}$	8	0.5	8
$1\frac{1}{2}$	11	0.5	6
2 or larger	18	0.5	4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 liquid ounce = 0.030 L, 1 gallon = 128 ounces.

C404.6.1 Circulation systems. Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

C404.6.2 Heat trace systems. Electric heat trace systems shall comply with IEEE 515.1. Controls for such systems shall be able to automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy. Heat trace shall be arranged to be turned off automatically when there is no hot water demand.

C404.6.3 Controls for hot water storage. The controls on pumps that circulate water between a water heater and a heated-water storage tank shall limit operation of the pump from heating cycle startup to not greater than 5 minutes after the end of the cycle.

C404.7 Demand recirculation controls. A water distribution system having one or more recirculation pumps that pump water from a heated-water supply pipe back to the heated-water source through a cold-water supply pipe shall be a demand recirculation water system. Pumps shall have controls that comply with both of the following:

1. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.
2. The control shall limit the temperature of the water entering the cold-water piping to 104°F (40°C).

C404.8 Drain water heat recovery units. Drain water heat recovery units shall comply with CSA B55.2. Potable water-

side pressure loss shall be less than 10 psi (69 kPa) at maximum design flow. For Group R occupancies, the efficiency of drain water heat recovery unit efficiency shall be in accordance with CSA B55.1.

C404.9 Energy consumption of pools and permanent spas. (Mandatory). The energy consumption of pools and permanent spas shall be controlled by the requirements in Subsections C404.9.1 through C404.9.3.

C404.9.1 Heaters. The electric power to all heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater, mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with continuously burning ignition pilots.

C404.9.2 Time switches. Time switches or other control methods that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this Section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

C404.9.3 Covers. Outdoor heated swimming pools and outdoor permanent spas shall be equipped with a vapor-retardant cover on or at the water surface or a liquid cover or other means proven to reduce heat loss.

Exception: Where more than 70 percent of the energy for heating, computed over an operating season, is from site-recovered energy such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

C404.10 Energy consumption of portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

C404.11 Service water-heating system commissioning and completion requirements. Service water-heating systems, swimming pool water-heating systems, spa water-heating systems and the controls for those systems shall be commissioned and completed in accordance with Subsection C408.2.

C404.12 Water flow rate controls.

C404.12.1 Showers. Showers used for other than safety reasons shall be equipped with flow control devices to limit the water discharge to a maximum of 2.5 gpm (.16 L/S) per showerhead at a distribution pressure of 80 psig (552 kPa) when tested in accordance with the procedures of ANSI A112.18.1M. Flow restricting inserts used as a component part of a showerhead shall be mechanically retained at the point of manufacture.

C404.12.2 Lavatories or restrooms of public facilities. Lavatories or restrooms of public facilities shall:

1. Be equipped with outlet devices that limit the flow of hot water to a maximum of 0.5 gpm (.03 L/S) or be equipped with self-closing valves that limit delivery to a per cycle maximum of 0.25 gallons (.95 L) of hot water for recirculating systems and to a maximum of 0.50 gallons (1.9 L) for non-recirculating systems.
Exception: Separate lavatories for physically handicapped persons shall not be equipped with self-closing valves.
2. Be equipped with devices that limit the outlet temperature to a maximum of 110°F (43°C).
3. Meet the provisions of 42 CFR 6295 (k), Standards for Water Closets and Urinals.

SECTION C405 ELECTRICAL POWER AND LIGHTING SYSTEMS

C405.1 General (Mandatory). This Section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.

Exception: Dwelling units within commercial buildings shall not be required to comply with Subsections C405.2 through C405.5, provided that they comply with Subsection R404.1.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Subsection C403.2.15 or C403.2.16.

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls as specified in Subsections C405.2.1, C405.2.2, C405.2.3, C405.2.4 and C405.2.5.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.

3. Emergency egress lighting that is normally off.

C405.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges.
5. Employee lunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
9. Janitorial closets.
10. Locker rooms.
11. Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.
12. Warehouses.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces other than warehouses specified in Subsection C405.2.1 shall comply with the following:

1. Automatically turn off lights within 30 minutes of all occupants leaving the space.
2. Be manual on or controlled to automatically turn the lighting on to not more than 50 percent power.

Exception: Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

3. Shall incorporate a manual control to allow occupants to turn lights off.

C405.2.1.2 Occupant sensor control function in warehouses. In warehouses, the lighting in aiseways and open areas shall be controlled with occupant sensors that automatically reduce lighting power by not less than 50 percent when the areas are unoccupied. The occupant sensors shall control lighting in each aisleway independently and shall not control lighting beyond the aisleway being controlled by the sensor.

C405.2.2 Time-switch controls. Each area of the building that is not provided with occupant sensor controls complying with Subsection C405.2.1.1 shall be provided with time switch controls complying with Subsection C405.2.2.1.

Exception: Where a manual control provides light reduction in accordance with Subsection C405.2.2.2, automatic controls shall not be required for the following:

1. Sleeping units.
2. Spaces where patient care is directly provided.

3. Spaces where an automatic shutoff would endanger occupant safety or security.
4. Lighting intended for continuous operation.
5. Shop and laboratory classrooms.

C405.2.2.1 Time-switch control function. Each space provided with time-switch controls shall also be provided with a manual control for light reduction in accordance with Subsection C405.2.2.2. Time-switch controls shall include an override switching device that complies with the following:

1. Have a minimum 7-day clock.
2. Be capable of being set for seven different day types per week.
3. Incorporate an automatic holiday “shutoff” feature, which turns off all controlled lighting loads for at least 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.
5. Include an override switch that complies with the following:
 - 5.1. The override switch shall be a manual control.
 - 5.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
 - 5.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m²).

Exceptions:

1. Within malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas:
 - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the override switch is a captive key device.
 - 1.2. The area controlled by the override switch is permitted to be greater than 5,000 square feet (465 m²), but shall not be greater than 20,000 square feet (1860 m²).
2. Where provided with manual control, the following areas are not required to have light reduction control:
 - 2.1. Spaces that have only one luminaire with a rated power of less than 100 watts.

- 2.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m²).

- 2.3. Corridors, equipment rooms, public lobbies, electrical or mechanical rooms.

C405.2.2.2 Light-reduction controls. Spaces required to have light-reduction controls shall have a manual control that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent. Lighting reduction shall be achieved by one of the following or another approved method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.

Exception: Light reduction controls are not required in daylight zones with daylight responsive controls complying with Subsection C405.2.3.

C405.2.2.3 Manual controls. Manual controls for lights shall comply with the following:

1. Shall be readily accessible to occupants.
2. Shall be located where the controlled lights are visible, or shall identify the area served by the lights and indicate their status.

C405.2.3 Daylight-responsive controls. Daylight-responsive controls complying with Subsection C405.2.3.1 shall be provided to control the electric lights within daylight zones in the following spaces:

1. Spaces with a total of more than 150 watts of general lighting within sidelight daylight zones complying with Subsection C405.2.3.2. General lighting does not include lighting that is required to have specific application control in accordance with Subsection C405.2.4.
2. Spaces with a total of more than 150 watts of general lighting within toplight daylight zones complying with Subsection C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Dwelling units and sleeping units.
3. Lighting that is required to have specific application control in accordance with Subsection C405.2.4.

4. Sidelight daylight zones on the first floor above grade in Group A-2 and Group M occupancies.

C405.2.3.1 Daylight-responsive control function.

Where required, daylight-responsive controls shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in toplight daylight zones in accordance with Subsection C405.2.3.3 shall be controlled independently of lights in sidelight daylight zones in accordance with Subsection C405.2.3.2.
2. Daylight responsive controls within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be readily accessible.
4. Where located in offices, classrooms, laboratories and library reading rooms, daylight responsive controls shall dim lights continuously from full light output to 15 percent of full light output or lower.
5. Daylight responsive controls shall be capable of a complete shutoff of all controlled lights.
6. Lights in sidelight daylight zones in accordance with Subsection C405.2.3.2 facing different cardinal orientations [i.e., within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

C405.2.3.2 Sidelight daylight zone. The sidelight daylight zone is the floor area adjacent to vertical fenestration which complies with all of the following:

1. Where the fenestration is located in a wall, the daylight zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2(1).
2. Where the fenestration is located in a rooftop monitor, the daylight zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.3.2(2) and C405.2.3.2(3).
3. The area of the fenestration is not less than 24 square feet (2.23 m²).

4. The distance from the fenestration to any building or geological formation which would block access to daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.

5. Where located in existing buildings, the visible transmittance of the fenestration is not less than 0.20.

C405.2.3.3 Toplight daylight zone. The toplight daylight zone is the floor area underneath a roof fenestration assembly which complies with all of the following:

1. The daylight zone shall extend laterally and longitudinally beyond the edge of the roof fenestration assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.3.3.
2. No building or geological formation blocks direct sunlight from hitting the roof fenestration assembly at the peak solar angle on the summer solstice.
3. Where located in existing buildings, the product of the visible transmittance of the roof fenestration assembly and the area of the rough opening of the roof fenestration assembly divided by the area of the daylight zone is not less than 0.008.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent light shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
2. Lighting in cases used for display case purposes shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
3. Hotel and motel sleeping units and guest suites shall have a master control device that is capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

Exception: Lighting and switched receptacles controlled by captive key systems.

4. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided that the control device is readily accessible.
5. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.
6. Lighting equipment that is for sale or for demonstrations in lighting education shall be controlled by a dedicated control that is independent of the controls for other lighting within the room or space.

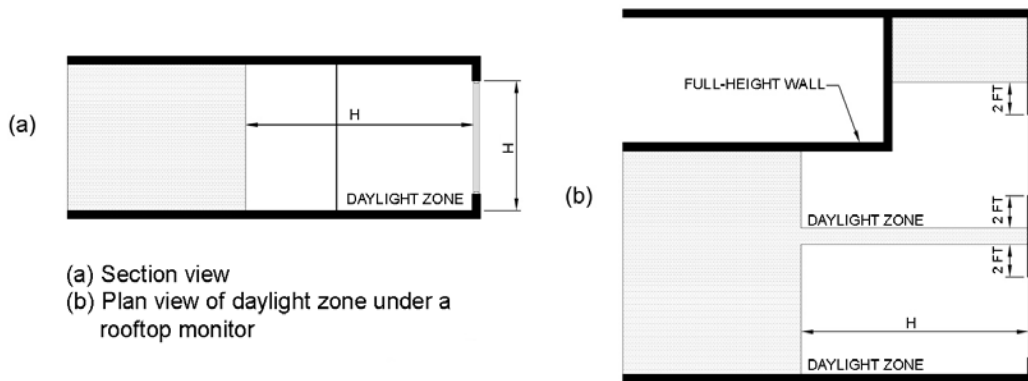


FIGURE C405.2.3.2(1)
DAYLIGHT ZONE ADJACENT TO FENESTRATION IN A WALL

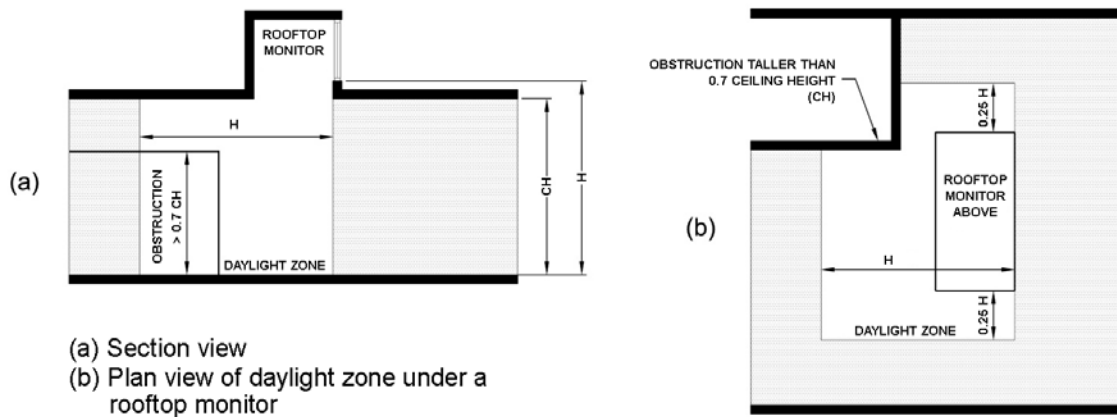


FIGURE C405.2.3.2(2)
DAYLIGHT ZONE UNDER A ROOFTOP MONITOR

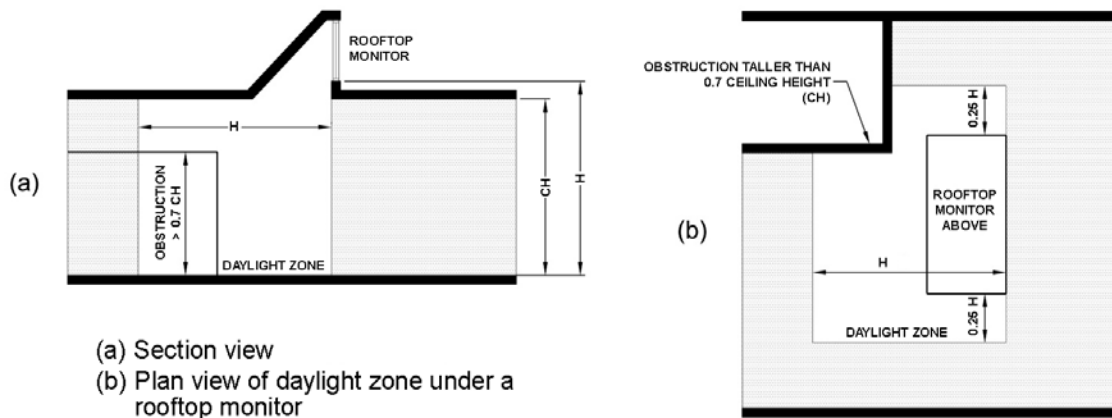


FIGURE C405.2.3.2(3)
DAYLIGHT ZONE UNDER A SLOPED ROOFTOP MONITOR

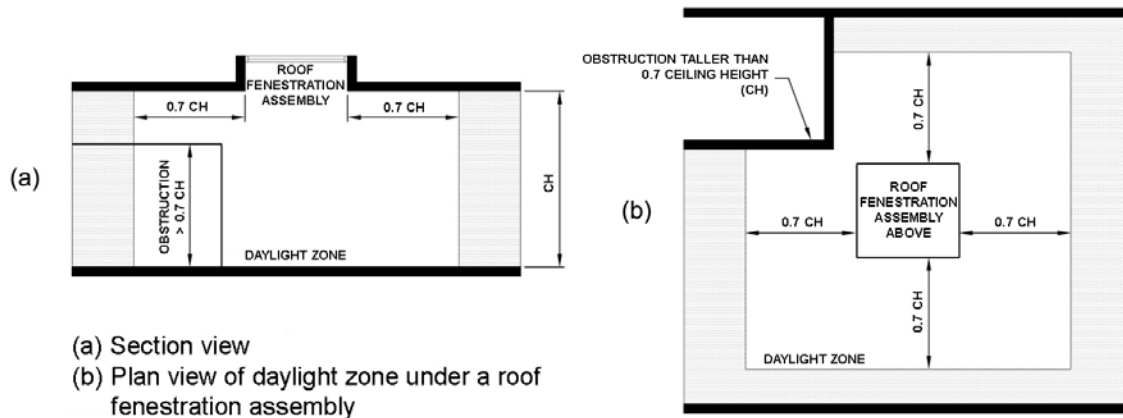


FIGURE C405.2.3.3
DAYLIGHT ZONE UNDER A ROOF FENESTRATION ASSEMBLY

C405.2.5 Exterior lighting controls. Lighting for exterior applications other than emergency lighting that is intended to be automatically off during building operation, lighting specifically required to meet health and life safety requirements or decorative gas lighting systems shall:

1. Be provided with a control that automatically turns off the lighting as a function of available daylight.
2. Where lighting the building façade or landscape, the lighting shall have controls that automatically shut off the lighting as a function of dawn/dusk and a set opening and closing time.
3. Where not covered in Item 2, the lighting shall have controls configured to automatically reduce the connected lighting power by not less than 30 percent from not later than midnight to 6 a.m., from one hour after business closing to one hour before business opening or during any period when activity has not been detected for a time of longer than 15 minutes.

All time switches shall be able to retain programming and the time setting during loss of power for a period of at least 10 hours.

Exception: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaptation.

C405.3 Exit signs (Mandatory). Internally illuminated exit signs shall not be more than 5 watts per side.

C405.4 Interior lighting power requirements (Prescriptive). A building complies with this Section where its total connected lighting power calculated under Subsection C405.4.1 is not greater than the interior lighting power calculated under Subsection C405.4.2.

C405.4.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-9.

$$TCLP = [SL + LV + LTPB + \text{Other}] \quad (\text{Equation 4-9})$$

where:

TCLP = Total connected lighting power (watts).

SL = Labeled wattage of luminaires for screw-in lamps.

LV = Wattage of the transformer supplying low-voltage lighting.

LTPB = Wattage of line-voltage lighting tracks and plug-in busways as the specified wattage of the luminaires, but at least 30 W/lin. ft. (100 W/lin m), or the wattage limit of the system's circuit breaker, or the wattage limit of other permanent current-limiting devices on the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other approved sources.

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
 - 1.1. Professional sports arena playing field lighting.
 - 1.2. Lighting in sleeping units, provided that the lighting complies with Subsection R404.1.
 - 1.3. Emergency lighting automatically off during normal building operation.
 - 1.4. Lighting in spaces specifically designed for use by occupants with

special lighting needs, including those with visual impairment and other medical and age-related issues.

- 1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.
- 1.6. Casino gaming areas.
- 1.7. Mirror lighting in dressing rooms.
2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:
 - 2.1. Task lighting for medical and dental purposes.
 - 2.2. Display lighting for exhibits in galleries, museums and monuments.
3. Lighting for theatrical purposes, including performance, stage, film production and video production.
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the manufacturer.
6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage.
8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.
9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in lighting education facilities.
11. Lighting approved because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
13. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

C405.4.2 Interior lighting power. The total interior lighting power allowance (watts) is determined according to Table C405.4.2(1) using the Building Area Method, or Table C405.4.2(2) using the Space-by-Space Method, for all areas of the building covered in this permit.

C405.4.2.1 Building Area Method. For the Building Area Method, the interior lighting power allowance is the floor area for each building area type listed in Table C405.4.2(1) times the value from Table C405.4.2(1) for that area. For the purposes of this method, an “area” shall be defined as all contiguous spaces that accommodate or are associated with a single building area type, as listed in Table C405.4.2(1). Where this method is used to calculate the total interior lighting power for an entire

building, each building area type shall be treated as a separate area.

C405.4.2.2 Space-by-Space Method. For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value for the space type in Table C405.4.2(2) that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces. Trade-offs among spaces are permitted.

C405.4.2.2.1 Additional interior lighting power.

Where using the Space-by-Space Method, an increase in the interior lighting power allowance is permitted for specific lighting functions. Additional power shall be permitted only where the specified lighting is installed and automatically controlled separately from the general lighting, to be turned off during nonbusiness hours. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose. An increase in the interior lighting power allowance is permitted in the following cases:

1. For lighting equipment to be installed in sales areas specifically to highlight merchandise, the additional lighting power shall be determined in accordance with Equation 4-10.

$$\text{Additional interior lighting power allowance} = 500 \text{ watts} + (\text{Retail Area 1} \cdot 0.6 \text{ W/ft}^2) + (\text{Retail Area 2} \cdot 0.6 \text{ W/ft}^2) + (\text{Retail Area 3} \cdot 1.4 \text{ W/ft}^2) + (\text{Retail Area 4} \cdot 2.5 \text{ W/ft}^2)$$

(Equation 4-10)

where:

Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.

Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.

Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories are permitted to be included in Retail Areas 2 through 4, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the Building Official.

2. For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance or for highlighting art or exhibits, provided that the additional lighting power shall be not more than 1.0 w/ft² (10.7 w/m²) of such spaces.

TABLE C405.4.2(1)
INTERIOR LIGHTING POWER ALLOWANCES:
BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft ²)
Automotive facility	0.80
Convention center	1.01
Courthouse	1.01
Dining: bar lounge/leisure	1.01
Dining: cafeteria/fast food	0.9
Dining: family	0.95
Dormitory	0.57
Exercise center	0.84
Fire station	0.67
Gymnasium	0.94
Health care clinic	0.90
Hospital	1.05
Hotel/Motel	0.87
Library	1.19
Manufacturing facility	1.17
Motion picture theater	0.76
Multifamily	0.51
Museum	1.02
Office	0.82
Parking garage	0.21
Penitentiary	0.81
Performing arts theater	1.39
Police station	0.87
Post office	0.87
Religious building	1.0
Retail	1.26
School/university	0.87
Sports arena	0.91
Town hall	0.89
Transportation	0.70
Warehouse	0.66
Workshop	1.19

TABLE C405.4.2(2)
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 per foot in total height
Greater than 40 feet in height	0.40 + 0.02 per foot in total height
Audience seating area	
In an auditorium	0.63
In a convention center	0.82
In a gymnasium	0.65
In a motion picture theater	1.14
In a penitentiary	0.28
In a performing arts theater	2.43
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	1.01
Breakroom (See Lounge/Breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	1.24
Conference/meeting/multipurpose room	1.23
Copy/print room	0.72
Corridor	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.92
In a hospital	0.79
In a manufacturing facility	0.41
Otherwise	0.66
Courtroom	1.72
Computer room	1.71
Dining area	
In a penitentiary	0.96
In a facility for the visually impaired (and not used primarily by the staff) ^b	1.9
In bar/lounge or leisure dining	1.07
In cafeteria or fast food dining	0.65
In family dining	0.89
Otherwise	0.65
Electrical/mechanical room	0.95
Emergency vehicle garage	0.56

(continued)

**TABLE C405.4.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD**

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Food preparation area	1.21
Guest room	0.47
Laboratory	
In or as a classroom	1.43
Otherwise	1.81
Laundry/washing area	0.6
Loading dock, interior	0.47
Lobby	
In a facility for the visually impaired (and not used primarily by the staff) ^b	1.8
For an elevator	0.64
In a hotel	1.06
In a motion picture theater	0.59
In a performing arts theater	2.0
Otherwise	0.9
Locker room	0.75
Lounge/breakroom	
In a healthcare facility	0.92
Otherwise	0.73
Office	
Enclosed	1.11
Open plan	0.98
Parking area, interior	0.19
Pharmacy area	1.68
Restroom	
In a facility for the visually impaired (and not used primarily by the staff) ^b	1.21
Otherwise	0.98
Sales area	1.59
Seating area, general	0.54
Stairway (See space containing stairway)	
Stairwell	0.69
Storage room	0.63
Vehicular maintenance area	0.67
Workshop	1.59
BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
Facility for the visually impaired ^b	
In a chapel (and not used primarily by the staff)	2.21
In a recreation room (and not used primarily by the staff)	2.41
Automotive (See Vehicular Maintenance Area above)	
Convention center—exhibit space	1.45
Dormitory—living quarters	0.38
Fire station—sleeping quarters	0.22
Gymnasium/fitness center	
In an exercise area	0.72
In a playing area	1.2

(continued)

**TABLE C405.4.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD**

BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
Healthcare facility	
In an exam/treatment room	1.66
In an imaging room	1.51
In a medical supply room	0.74
In a nursery	0.88
In a nurse's station	0.71
In an operating room	2.48
In a patient room	0.62
In a physical therapy room	0.91
In a recovery room	1.15
Library	
In a reading area	1.06
In the stacks	1.71
Manufacturing facility	
In a detailed manufacturing area	1.29
In an equipment room	0.74
In an extra high bay area (greater than 50' floor-to-ceiling height)	1.05
In a high bay area (25-50' floor-to-ceiling height)	1.23
In a low bay area (less than 25' floor-to-ceiling height)	1.19
Museum	
In a general exhibition area	1.05
In a restoration room	1.02
Performing arts theater—dressing room	0.61
Post office—sorting area	0.94
Religious buildings	
In a fellowship hall	0.64
In a worship/pulpit/choir area	1.53
Retail facilities	
In a dressing/fitting room	0.71
In a mall concourse	1.1
Sports arena—playing area	
For a Class I facility	3.68
For a Class II facility	2.4
For a Class III facility	1.8
For a Class IV facility	1.2
Transportation facility	
In a baggage/carousel area	0.53
In an airport concourse	0.36
At a terminal ticket counter	0.8
Warehouse—storage area	
For medium to bulky, palletized items	0.58
For smaller, hand-carried items	0.95

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.

C405.5 Exterior lighting (Mandatory). Where the power for exterior lighting is supplied through the energy service to the building, all exterior lighting shall comply with Subsection C405.5.1.

Exception: Where approved because of historical, safety, signage or emergency considerations.

C405.5.1 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table C405.5.1(2) for the applicable lighting zone. Trade-offs are allowed only among exterior lighting applications listed in Table C405.5.1(2), in the Tradable Surfaces section. The lighting zone for the building exterior is determined from Table C405.5.1(1) unless otherwise specified by the local jurisdiction.

Exception: Lighting used for the following exterior applications is exempt where equipped with a control device independent of the control of the nonexempt lighting:

1. Specialized signal, directional and marker lighting associated with transportation.
2. Advertising signage or directional signage.
3. Integral to equipment or instrumentation and is installed by its manufacturer.
4. Theatrical purposes, including performance, stage, film production and video production.
5. Athletic playing areas.
6. Temporary lighting.
7. Industrial production, material handling, transportation sites and associated storage areas.
8. Theme elements in theme/amusement parks.
9. Used to highlight features of public monuments and registered historic landmark structures or buildings.

C405.6 Electrical power (Mandatory).

C405.6.1 Applicability. This Section applies to all building power distribution systems. The provisions for electrical distribution for all sections of this Code are subject to the design conditions in ASHRAE Standard 90.1.

C405.6.2 Electrical metering. In buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

C405.6.3 Voltage drop. The conductors for feeders and branch circuits combined shall be sized for a maximum of 5 percent voltage drop total.

C405.6.4 Completion requirements.

C405.6.4.1 Drawings. Construction documents shall require that within 30 days after the date of system acceptance, record drawings of the actual installation shall be provided to the building owner, including:

1. a single-line diagram of the building electrical distribution system, and
2. floor plans indicating location and area served for all distribution.

C405.6.4.2 Manuals. Construction documents shall require that an operating manual and maintenance manual be provided to the building owner. The manuals shall include, at a minimum, the following:

1. Submittal data stating equipment rating and selected options for each piece of equipment requiring maintenance.
2. Operation manuals and maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one qualified service agency.

Note: Enforcement agencies should only check to be sure that the construction documents require this information to be transmitted to the owner and should not expect copies of any of the materials.

C405.7 Electrical transformers (Mandatory). Electric transformers shall meet the minimum efficiency requirements of Table C405.7 as tested and rated in accordance with the test procedure listed in DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the transformer manufacturer.

Exceptions: The following transformers are exempt:

1. Transformers that meet the *Energy Policy Act of 2005* exclusions based on the DOE 10 CFR 431 definition of special purpose applications.
2. Transformers that meet the *Energy Policy Act of 2005* exclusions that are not to be used in general purpose applications based on information provided in DOE 10 CFR 431.

**TABLE C405.5.1(1)
EXTERIOR LIGHTING ZONES**

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed-use areas
3	All other areas not classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

TABLE C405.5.1(2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance (Base allowance is usable in tradable or nontradable surfaces.)		500 W	600 W	750 W	1300 W
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	Uncovered Parking Areas				
	Parking areas and drives	0.04 W/ft ²	0.06 W/ft ²	0.10 W/ft ²	0.13 W/ft ²
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater, plaza areas special feature areas	0.14 W/ft ²	0.14 W/ft ²	0.16 W/ft ²	0.2 W/ft ²
	Stairways	0.75 W/ft ²	1.0 W/ft ²	1.0 W/ft ²	1.0 W/ft ²
	Pedestrian tunnels	0.15 W/ft ²	0.15 W/ft ²	0.2 W/ft ²	0.3 W/ft ²
	Building Entrances and Exits				
	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
	Entry canopies	0.25 W/ft ²	0.25 W/ft ²	0.4 W/ft ²	0.4 W/ft ²
	Sales Canopies				
	Free-standing and attached	0.6 W/ft ²	0.6 W/ft ²	0.8 W/ft ²	1.0 W/ft ²
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.25 W/ft ²	0.25 W/ft ²	0.5 W/ft ²	0.7 W/ft ²
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	Building facades	No allowance	0.075 W/ft ² of gross above-grade wall area	0.113 W/ft ² of gross above-grade wall area	0.15 W/ft ² of gross above-grade wall area
	Automated teller machines (ATM) and night depositories	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	0.75 W/ft ² of covered and uncovered area	0.75 W/ft ² of covered and uncovered area	0.75 W/ft ² of covered and uncovered area	0.75 W/ft ² of covered and uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area
	Drive-up windows/doors	400 W per drive-through	400 W per drive-through	400 W per drive-through	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry	800 W per main entry	800 W per main entry	800 W per main entry

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

W = watts.

3. Transformers that meet the *Energy Policy Act of 2005* exclusions with multiple voltage taps where the highest tap is at least 20 percent more than the lowest tap.
4. Drive transformers.
5. Rectifier transformers.
6. Auto-transformers.
7. Uninterruptible power system transformers.
8. Impedance transformers.
9. Regulating transformers.
10. Sealed and nonventilating transformers.
11. Machine tool transformers.
12. Welding transformers.
13. Grounding transformers.
14. Testing transformers.

C405.8 Electrical motors (Mandatory). Electric motors shall meet the minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with the DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the motor manufacturer.

C405.9 Vertical and horizontal transportation systems and equipment. Vertical and horizontal transportation systems and equipment shall comply with this Section.

C405.9.1 Elevator cabs. For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be not less than 35 lumens per watt. Ventilation fans in elevators that do not have their own air-conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is

stopped, unoccupied and with its doors closed for over 15 minutes.

C405.9.2 Escalators and moving walks. Escalators and moving walks shall comply with ASME A17.1/CSA B44 and shall have automatic controls configured to reduce speed to the minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers.

C405.9.2.1 Regenerative drive. An escalator designed either for one-way down operation only or for reversible operation shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded with passengers whose combined weight exceeds 750 pounds (340 kg).

SECTION C406

ADDITIONAL EFFICIENCY PACKAGE OPTIONS

C406.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with Subsection C406.2.
2. Reduced lighting power density system in accordance with Subsection C406.3.
3. Enhanced lighting controls in accordance with Subsection C406.4.
4. On-site supply of renewable energy in accordance with Subsection C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Subsection C406.6.
6. High-efficiency service water heating in accordance with Subsection C406.7.

C406.1.1 Tenant spaces. Tenant spaces shall comply with Subsection C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, tenant spaces shall comply with Subsection C406.5 where the entire building is in compliance.

TABLE C405.7
MINIMUM NOMINAL EFFICIENCY LEVELS FOR 10 CFR 431 LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS

SINGLE-PHASE TRANSFORMERS		THREE-PHASE TRANSFORMERS	
kVA ^a	Efficiency (%) ^b	kVA ^a	Efficiency (%) ^b
15	97.7	15	97.0
25	98.0	30	97.5
37.5	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
167	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
		750	98.8
		1000	98.9

a. kiloVolt-Amp rating.

b. Nominal efficiencies shall be established in accordance with the DOE 10 CFR 431 test procedure for low-voltage dry-type transformers.

C406.2 More efficient HVAC equipment performance.

Equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. Variable refrigerant flow systems shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. Equipment not listed in Tables C403.2.3(1) through C403.2.3(7) shall be limited to 10 percent of the total building system capacity.

C406.3 Reduced lighting power density. The total interior lighting power (watts) of the building shall be determined by using 90 percent of the lighting power values specified in

Table C405.4.2(1) times the floor area for the building types, or by using 90 percent of the interior lighting power allowance calculated by the Space-by-Space Method in Subsection C405.4.2.

C406.4 Enhanced digital lighting controls. Interior lighting in the building shall have the following enhanced lighting controls that shall be located, scheduled and operated in accordance with Subsection C405.2.2.

1. Luminaires shall be capable of continuous dimming.
2. Luminaires shall be capable of being addressed individually. Where individual addressability is not available for the luminaire class type, a controlled group of not more than four luminaries shall be allowed.

TABLE C405.8(1)
MINIMUM NOMINAL FULL-LOAD EFFICIENCY FOR 60 HZ NEMA
GENERAL PURPOSE ELECTRIC MOTORS (SUBTYPE I) RATED 600 VOLTS OR LESS (Random Wound)^a

MOTOR HORSEPOWER	NUMBER OF POLES	OPEN DRIP-PROOF MOTORS			TOTALLY ENCLOSED FAN-COOLED MOTORS		
		2	4	6	2	4	6
	Synchronous Speed (RPM)	3600	1800	1200	3600	1800	1200
1		77.0	85.5	82.5	77.0	85.5	82.5
1.5		84.0	86.5	86.5	84.0	86.5	87.5
2		85.5	86.5	87.5	85.5	86.5	88.5
3		85.5	89.5	88.5	86.5	89.5	89.5
5		86.5	89.5	89.5	88.5	89.5	89.5
7.5		88.5	91.0	90.2	89.5	91.7	91.0
10		89.5	91.7	91.7	90.2	91.7	91.0
15		90.2	93.0	91.7	91.0	92.4	91.7
20		91.0	93.0	92.4	91.0	93.0	91.7
25		91.7	93.6	93.0	91.7	93.6	93.0
30		91.7	94.1	93.6	91.7	93.6	93.0
40		92.4	94.1	94.1	92.4	94.1	94.1
50		93.0	94.5	94.1	93.0	94.5	94.1
60		93.6	95.0	94.5	93.6	95.0	94.5
75		93.6	95.0	94.5	93.6	95.4	94.5
100		93.6	95.4	95.0	94.1	95.4	95.0
125		94.1	95.4	95.0	95.0	95.4	95.0
150		94.1	95.8	95.4	95.0	95.8	95.8
200		95.0	95.8	95.4	95.4	96.2	95.8
250		95.0	95.8	95.4	95.8	96.2	95.8
300		95.4	95.8	95.4	95.8	96.2	95.8
350		95.4	95.8	95.4	95.8	96.2	95.8
400		95.8	95.8	95.8	95.8	96.2	95.8
450		95.8	96.2	96.2	95.8	96.2	95.8
500		95.8	96.2	96.2	95.8	96.2	95.8

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

TABLE C405.8(2)
MINIMUM NOMINAL FULL-LOAD EFFICIENCY OF
GENERAL PURPOSE ELECTRIC MOTORS (SUBTYPE II) AND ALL DESIGN B MOTORS GREATER THAN 200 HORSEPOWER^a

MOTOR HORSEPOWER	NUMBER OF POLES	OPEN DRIP-PROOF MOTORS				TOTALLY ENCLOSED FAN-COOLED MOTORS			
		2	4	6	8	2	4	6	8
	Synchronous Speed (RPM)	3600	1800	1200	900	3600	1800	1200	900
1		NR	82.5	80.0	74.0	75.5	82.5	80.0	74.0
1.5		82.5	84.0	84.0	75.5	82.5	84.0	85.5	77.0
2		84.0	84.0	85.5	85.5	84.0	84.0	86.5	82.5
3		84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0
5		85.5	87.5	87.5	87.5	87.5	87.5	87.5	84.0
7.5		87.5	88.5	88.5	88.5	88.5	89.5	89.5	85.5
10		88.5	89.5	90.2	89.5	89.5	89.5	89.5	88.5
15		89.5	91.0	90.2	89.5	90.2	91.0	90.2	88.5
20		90.2	91.0	91.0	90.2	90.2	91.0	90.2	89.5
25		91.0	91.7	91.7	90.2	91.0	92.4	91.7	89.5
30		91.0	92.4	92.4	91.0	91.0	92.4	91.7	91.0
40		91.7	93.0	93.0	91.0	91.7	93.0	93.0	91.0
50		92.4	93.0	93.0	91.7	92.4	93.0	93.0	91.7
60		93.0	93.6	93.6	92.4	93.0	93.6	93.6	91.7
75		93.0	94.1	93.6	93.6	93.0	94.1	93.6	93.0
100		93.0	94.1	94.1	93.6	93.6	94.5	94.1	93.0
125		93.6	94.5	94.1	93.6	94.5	94.5	94.1	93.6
150		93.6	95.0	94.5	93.6	94.5	95.0	95.0	93.6
200		94.5	95.0	94.5	93.6	95.0	95.0	95.0	94.1
250		94.5	95.4	95.4	94.5	95.4	95.0	95.0	94.5
300		95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
350		95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
400		95.4	95.4	NR	NR	95.4	95.4	NR	NR
450		95.8	95.8	NR	NR	95.4	95.4	NR	NR
500		95.8	95.8	NR	NR	95.4	95.8	NR	NR

NR = No requirement.

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

TABLE C405.8(3)
MINIMUM AVERAGE FULL-LOAD EFFICIENCY POLYPHASE SMALL ELECTRIC MOTORS^a

MOTOR HORSEPOWER	OPEN MOTORS			
	Number of Poles	2	4	6
	Synchronous Speed (RPM)	3600	1800	1200
0.25		65.6	69.5	67.5
0.33		69.5	73.4	71.4
0.50		73.4	78.2	75.3
0.75		76.8	81.1	81.7
1		77.0	83.5	82.5
1.5		84.0	86.5	83.8
2		85.5	86.5	N/A
3		85.5	86.9	N/A

a. Average full-load efficiencies shall be established in accordance with 10 CFR 431.

TABLE C405.8(4)
MINIMUM AVERAGE FULL-LOAD EFFICIENCY FOR
CAPACITOR-START CAPACITOR-RUN AND CAPACITOR-START INDUCTION-RUN SMALL ELECTRIC MOTORS^a

MOTOR HORSEPOWER	OPEN MOTORS			
	Number of Poles	2	4	6
	Synchronous Speed (RPM)	3600	1800	1200
0.25		66.6	68.5	62.2
0.33		70.5	72.4	66.6
0.50		72.4	76.2	76.2
0.75		76.2	81.8	80.2
1		80.4	82.6	81.1
1.5		81.5	83.8	N/A
2		82.9	84.5	N/A
3		84.1	N/A	N/A

a. Average full-load efficiencies shall be established in accordance with 10 CFR 431.

3. Not more than eight luminaires shall be controlled together in a daylight zone.
4. Fixtures shall be controlled through a digital control system that includes the following function:
 - 4.1. Control reconfiguration based on digital addressability.
 - 4.2. Load shedding.
 - 4.3. Individual user control of overhead general illumination in open offices.
 - 4.4. Occupancy sensors shall be capable of being reconfigured through the digital control system.
5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions in Item 4 of this Section.
6. Functional testing of lighting controls shall comply with Section C408.

C406.5 On-site renewable energy. Total minimum ratings of on-site renewable energy systems shall comply with one of the following:

1. Provide not less than 0.50 watts per square foot (5.4 W/m²) of conditioned floor area.

2. Provide not less than 3 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

C406.6 Dedicated outdoor air system. Buildings covered by Subsection C403.4 shall be equipped with an independent ventilation system designed to provide not less than the minimum 100-percent outdoor air to each individual occupied space, as specified by the *EPCOT Mechanical Code*. The ventilation system shall be capable of total energy recovery. The HVAC system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature at least 25 percent of the difference between the design supply-air temperature and the design room-air temperature.

C406.7 Reduced energy use in service water heating. Buildings shall be of the following types to use this compliance method:

1. Group R-1: Boarding houses, hotels or motels.
2. Group I-2: Hospitals, psychiatric hospitals and nursing homes.

3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.
4. Group F: Laundries.
5. Group R-2: Buildings with residential occupancies.
6. Group A-3: Health clubs and spas.
7. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

C406.7.1 Load fraction. The building service water-heating system shall have one or more of the following that are sized to provide not less than 60 percent of hot water requirements, or sized to provide 100 percent of hot water requirements if the building shall otherwise comply with Subsection C403.4.5.

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, process equipment, or a combined heat and power system.
2. Solar water-heating systems.

SECTION C407 TOTAL BUILDING PERFORMANCE

C407.1 Scope. This Section establishes criteria for compliance using total building performance. The following systems and loads shall be included in determining the total building performance: heating systems, cooling systems, service water heating, fan systems, lighting power, receptacle loads and process loads.

C407.2 Mandatory requirements. Compliance with this Section requires that the criteria of Subsections C402.5, C403.2, C404 and C405 be met.

C407.2.1 Roof/ceiling thermal envelope. The roof or ceiling that functions as the building's thermal envelope shall be insulated to an *R*-value of at least R-10. Multiple-family residential roofs/ceilings shall be insulated to an *R*-value of at least R-19, space permitting. Where cavities beneath a roof deck are ventilated, the ceiling shall be considered the envelope component utilized in the Commission approved compliance software tools.

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices used in the total building performance compliance calculation shall be those contained in software approved by the Florida Building Commission. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the proposed design.

C407.4 Documentation. Documentation verifying that the methods and accuracy of compliance software tools conform to the provisions of this Section shall be provided to the Florida Building Commission. Computer software utilized for demonstration of code compliance shall have been approved by the Florida Building Commission in accordance with requirements of this Code.

C407.4.1 Compliance report. Compliance software tools used to demonstrate code compliance by Section C407 shall generate a report that documents that the proposed design has annual energy costs less than or equal to the annual energy costs of the standard reference design. The compliance documentation shall include the following information:

1. Address of the building;
2. An inspection checklist documenting the building component characteristics of the proposed design as listed in Table C407.5.1(1). The inspection checklist shall show the estimated annual energy cost for both the standard reference design and the proposed design;
3. Name of individual completing the compliance report; and
4. Name and version of the compliance software tool.

C407.4.2 Additional documentation. The Building Official shall be permitted to require the following documents:

1. Thermal zoning diagrams consisting of floor plans showing the thermal zoning scheme for standard reference design and proposed design;
2. Input and output reports from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end-use served, total hours that space conditioning loads are not met and any errors or warning messages generated by the simulation tool as applicable;
3. An explanation of any error or warning messages appearing in the simulation tool output; and
4. A certification signed by the builder providing the building component characteristics of the proposed design as given in Table C407.5.1(1).

C407.5 Calculation procedure. Except as specified by this Section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

C407.5.1 Building specifications. The standard reference design and proposed design shall be configured and analyzed as specified by Table C407.5.1(1). Table C407.5.1(1) shall include by reference all notes contained in Table C402.1.4.

C407.5.2 Thermal blocks. The standard reference design and proposed design shall be analyzed using identical thermal blocks as specified in Subsection C407.5.2.1, C407.5.2.2 or C407.5.2.3.

C407.5.2.1 HVAC zones designed. Where HVAC zones are defined on HVAC design drawings, each HVAC zone shall be modeled as a separate thermal block.

Exception: Different HVAC zones shall be allowed to be combined to create a single thermal block or identical thermal blocks to which multipliers are applied provided:

1. The space use classification is the same throughout the thermal block.

2. All HVAC zones in the thermal block that are adjacent to glazed exterior walls face the same orientation or their orientations are within 45 degrees (0.79 rad) of each other.
3. All of the zones are served by the same HVAC system or by the same kind of HVAC system.

C407.5.2.2 HVAC zones not designed. Where HVAC zones have not yet been designed, thermal blocks shall be defined based on similar internal load densities, occupancy, lighting, thermal and temperature schedules, and in combination with the following guidelines:

1. Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located more than 15 feet (4572 mm) from an exterior wall. Perimeter spaces shall be those located closer than 15 feet (4572 mm) from an exterior wall.
2. Separate thermal blocks shall be assumed for spaces adjacent to glazed exterior walls: a separate zone shall be provided for each orientation, except orientations that differ by not more than 45 degrees (0.79 rad) shall be permitted to be considered to be the same orientation. Each zone shall include floor area that is 15 feet (4572 mm) or less from a glazed perimeter wall, except that floor area within 15 feet (4572 mm) of glazed perimeter walls having more than one orientation shall be divided proportionately between zones.
3. Separate thermal blocks shall be assumed for spaces having floors that are in contact with the ground or exposed to ambient conditions from zones that do not share these features.
4. Separate thermal blocks shall be assumed for spaces having exterior ceiling or roof assemblies from zones that do not share these features.

C407.5.2.3 Multifamily residential buildings. Residential spaces shall be modeled using one thermal block per space except that those facing the same orientations are permitted to be combined into one thermal block. Corner units and units with roof or floor loads shall only be combined with units sharing these features.

C407.5.2.4 Requirements specific to credit options. Credit may be claimed in the compliance calculation for technologies that meet the criteria for various options specified below.

C407.5.2.4.1 Vegetative roofs. Credit may be claimed in whole building performance method calculations for the area of a proposed building's roof that is covered with a vegetative roof that is designed and installed in accordance with ANSI/SPRI VF-1, with a minimum growth media depth of 4 inches. The credit shall provide a 45 percent reduction in the heating and cooling roof heat flux rates for the roof area covered with the vegetative

roof. Minimum roof/ceiling insulation levels shall be code minimums as per Subsection C407.2.1.

C407.5.2.4.2 Enthalpy Recovery Ventilation systems (ERVs). Credit may be claimed in the whole building performance method calculations for Enthalpy Recovery Ventilation systems used in the proposed building. This credit is applicable for buildings in which every HVAC system has a design supply airflow of less than 5,000 cfm. The credit shall also be applicable to buildings where one or more HVAC systems in the building have a design supply flow equal to 5,000 cfm or greater but shall have minimum outdoor air supply less than 70 percent of the design supply airflow for that HVAC system.

The credit shall provide for a reduction of 6 percent of total HVAC annual energy use for buildings located in Climate Zone 1 and 4 percent of total HVAC annual energy use for buildings located in Climate Zone 2.

C407.6 Calculation software tools. Calculation procedures used to comply with this Section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities.

1. Building operation for a full calendar year (8,760 hours).
2. Climate data for a full calendar year (8,760 hours) and shall reflect approved coincident hourly data for temperature, solar radiation, humidity and wind speed for the building location.
3. Ten or more thermal zones.
4. Thermal mass effects.
5. Hourly variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads.
6. Part-load performance curves for mechanical equipment.
7. Capacity and efficiency correction curves for mechanical heating and cooling equipment.
8. Printed Building Official inspection checklist listing each of the proposed design component characteristics from Table C407.5.1(1) determined by the analysis to provide compliance, along with their respective performance ratings including, but not limited to, *R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER, EF.

C407.6.1 Specific approval. Performance analysis tools meeting the applicable subsections of Section C407 and tested according to ASHRAE Standard 140 shall be permitted to be approved by the Florida Building Commission. The Building Official shall be permitted to approve tools for a specified application or limited scope in accordance with Subsection C101.4.3.

TABLE C407.5.1(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Space use classification	Same as proposed	The space use classification shall be chosen in accordance with Table C405.5.2 for all areas of the building covered by this permit. Where the space use classification for a building is not known, the building shall be categorized as an office building.
Roofs	Type: Insulation entirely above deck	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, above-grade	Type: Mass wall where proposed wall is mass; otherwise steel-framed wall	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: Mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interior side of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Floors, slab-on-grade	Type: Unheated	As proposed
	F-factor: as specified in Table C402.1.4	As proposed
Opaque doors	Type: Swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Vertical fenestration other than opaque doors	Area 1. The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2. 40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	External shading and PF: None	As proposed
Skylights	Area 1. The proposed skylight area; where the proposed skylight area is less than that permitted by Subsection C402.1. 2. The area permitted by Subsection C402.1; where the proposed skylight area exceeds that permitted by Subsection C402.1.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Subsection C405.4.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 Watt per square foot (10.7 W/m ²) based on the categorization of buildings with unknown space classification as offices.	As proposed
Lighting, exterior	The lighting power shall be determined in accordance with Table C405.5.2(2). Areas and dimensions of tradable and nontradable surfaces shall be the same as proposed.	As proposed

(continued)

TABLE C407.5.1(1)—continued
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. All end-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.
Schedules	Same as proposed	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Mechanical ventilation	Same as proposed	As proposed, in accordance with Subsection C403.2.6.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type ^a : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(4) and C403.2.3(5)	As proposed
	Capacity ^b : sized proportionally to the capacities in the proposed design based on sizing runs	As proposed
Cooling systems	Fuel type: same as proposed design	As proposed
	Equipment type ^c : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.2.3(1), C403.2.3(2) and C403.2.3(3)	As proposed
	Capacity ^b : sized proportionally to the capacities in the proposed design based on sizing runs	As proposed
	Economizer ^d : same as proposed, in accordance with Subsection C403.3.	As proposed
Service water heating ^e	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For Group R, as proposed multiplied by SWHF. For other than Group R, as proposed multiplied by efficiency as provided by the manufacturer of the DWHR unit.
	Capacity: same as proposed	As proposed
	Where no service water hot water system exists or is specified in the proposed design, no service hot water heating shall be modeled.	

SWHF = Service water heat recovery factor, DWHR = Drain water heat recovery.

- Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.
- The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.
- Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.
- If an economizer is required in accordance with Table C403.3 and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Subsection C403.3.
- The SWHF shall be applied as follows:
 - Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.36)]$.
 - Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.33)]$.
 - Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.26)]$.
 - Where Items 1 through 3 are not met, $SWHF = 1.0$.

TABLE C407.5.1(2)
HVAC SYSTEMS MAP

CONDENSER COOLING SOURCE ^a	HEATING SYSTEM CLASSIFICATION ^b	STANDARD REFERENCE DESIGN HVAC SYSTEM TYPE ^c		
		Single-zone Residential System	Single-zone Nonresidential System	All Other
Water/ground	Electric resistance	System 5	System 5	System 1
	Heat pump	System 6	System 6	System 6
	Fossil fuel	System 7	System 7	System 2
Air/none	Electric resistance	System 8	System 9	System 3
	Heat pump	System 8	System 9	System 3
	Fossil fuel	System 10	System 11	System 4

- a. Select “water/ground” where the proposed design system condenser is water or evaporatively cooled; select “air/none” where the condenser is air cooled. Closed-circuit dry coolers shall be considered air cooled. Systems utilizing district cooling shall be treated as if the condenser water type were “water.” Where no mechanical cooling is specified or the mechanical cooling system in the proposed design does not require heat rejection, the system shall be treated as if the condenser water type were “Air.” For proposed designs with ground-source or groundwater-source heat pumps, the standard reference design HVAC system shall be water-source heat pump (System 6).
- b. Select the path that corresponds to the proposed design heat source: electric resistance, heat pump (including air source and water source), or fuel fired. Systems utilizing district heating (steam or hot water) and systems with no heating capability shall be treated as if the heating system type were “fossil fuel.” For systems with mixed fuel heating sources, the system or systems that use the secondary heating source type (the one with the smallest total installed output capacity for the spaces served by the system) shall be modeled identically in the standard reference design and the primary heating source type shall be used to determine standard reference design HVAC system type.
- c. Select the standard reference design HVAC system category: The system under “single-zone residential system” shall be selected where the HVAC system in the proposed design is a single-zone system and serves a residential space. The system under “single-zone nonresidential system” shall be selected where the HVAC system in the proposed design is a single-zone system and serves other than residential spaces. The system under “all other” shall be selected for all other cases.

TABLE C407.5.1(3)
SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN HVAC SYSTEM DESCRIPTIONS

SYSTEM NO.	SYSTEM TYPE	FAN CONTROL	COOLING TYPE	HEATING TYPE
1	Variable air volume with parallel fan-powered boxes ^a	VAV ^d	Chilled water ^e	Electric resistance
2	Variable air volume with reheat ^b	VAV ^d	Chilled water ^e	Hot water fossil fuel boiler ^f
3	Packaged variable air volume with parallel fan-powered boxes ^a	VAV ^d	Direct expansion ^e	Electric resistance
4	Packaged variable air volume with reheat ^b	VAV ^d	Direct expansion ^e	Hot water fossil fuel boiler ^f
5	Two-pipe fan coil	Constant volume ⁱ	Chilled water ^e	Electric resistance
6	Water-source heat pump	Constant volume ⁱ	Direct expansion ^e	Electric heat pump and boiler ^g
7	Four-pipe fan coil	Constant volume ⁱ	Chilled water ^e	Hot water fossil fuel boiler ^f
8	Packaged terminal heat pump	Constant volume ⁱ	Direct expansion ^e	Electric heat pump ^h
9	Packaged rooftop heat pump	Constant volume ⁱ	Direct expansion ^e	Electric heat pump ^h
10	Packaged terminal air conditioner	Constant volume ⁱ	Direct expansion	Hot water fossil fuel boiler ^f
11	Packaged rooftop air conditioner	Constant volume ⁱ	Direct expansion	Fossil fuel furnace

For SI: 1 foot = 304.8 mm, 1 cfm/ft² = 0.4719 L/s, 1 Btu/h = 0.293/W, °C = [(°F) - 32]/1.8.

- a. **VAV with parallel boxes:** Fans in parallel VAV fan-powered boxes shall be sized for 50 percent of the peak design flow rate and shall be modeled with 0.35 W/cfm fan power. Minimum volume setpoints for fan-powered boxes shall be equal to the minimum rate for the space required for ventilation consistent with Subsection C403.4.4, Exception 4. Supply air temperature setpoint shall be constant at the design condition.
- b. **VAV with reheat:** Minimum volume setpoints for VAV reheat boxes shall be 0.4 cfm/ft² of floor area. Supply air temperature shall be reset based on zone demand from the design temperature difference to a 10°F temperature difference under minimum load conditions. Design airflow rates shall be sized for the reset supply air temperature, i.e., a 10°F temperature difference.
- c. **Direct expansion:** The fuel type for the cooling system shall match that of the cooling system in the proposed design.
- d. **VAV:** Where the proposed design system has a supply, return or relief fan motor 25 hp or larger, the corresponding fan in the VAV system of the standard reference design shall be modeled assuming a variable-speed drive. For smaller fans, a forward-curved centrifugal fan with inlet vanes shall be modeled. Where the proposed design's system has a direct digital control system at the zone level, static pressure setpoint reset based on zone requirements in accordance with Subsection C403.4.1 shall be modeled.
- e. **Chilled water:** For systems using purchased chilled water, the chillers are not explicitly modeled and chilled water costs shall be based as determined in Subsections C407.3 and C407.5.2. Otherwise, the standard reference design's chiller plant shall be modeled with chillers having the number as indicated in Table C407.5.1(4) as a function of standard reference building chiller plant load and type as indicated in Table C407.5.1(5) as a function of individual chiller load. Where chiller fuel source is mixed, the system in the standard reference design shall have chillers with the same fuel types and with capacities having the same proportional capacity as the proposed design's chillers for each fuel type. Chilled water supply temperature shall be modeled at 44°F design supply temperature and 56°F return temperature. Piping losses shall not be modeled in either building model. Chilled water supply water temperature shall be reset in accordance with Subsection C403.4.3.3. Pump system power for each pumping system shall be the same as the proposed design; where the proposed design has no chilled water pumps, the standard reference design pump power shall be 22 W/gpm (equal to a pump operating against a 75-foot head, 65-percent combined impeller and motor efficiency). The chilled water system shall be modeled as primary-only variable flow with flow maintained at the design rate through each chiller using a bypass. Chilled water pumps shall be modeled as riding the pump curve or with variable-speed drives when required in Subsection C403.4.3.3. The heat rejection device shall be an axial fan cooling tower with two-speed fans where required in Subsection C403.4.3. Condenser water design supply temperature shall be 85°F or 10°F approach to design wet-bulb temperature, whichever is lower, with a design temperature rise of 10°F. The tower shall be controlled to maintain a 70°F leaving water temperature where weather permits, floating up to leaving water temperature at design conditions. Pump system power for each pumping system shall be the same as the proposed design; where the proposed design has no condenser water pumps, the standard reference design pump power shall be 19 W/gpm (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). Each chiller shall be modeled with separate condenser water and chilled water pumps interlocked to operate with the associated chiller.
- f. **Fossil fuel boiler:** For systems using purchased hot water or steam, the boilers are not explicitly modeled and hot water or steam costs shall be based on actual utility rates. Otherwise, the boiler plant shall use the same fuel as the proposed design and shall be natural draft. The standard reference design boiler plant shall be modeled with a single boiler where the standard reference design plant load is 600,000 Btu/h and less and with two equally sized boilers for plant capacities exceeding 600,000 Btu/h. Boilers shall be staged as required by the load. Hot water supply temperature shall be modeled at 180°F design supply temperature and 130°F return temperature. Piping losses shall not be modeled in either building model. Hot water supply water temperature shall be reset in accordance with Subsection C403.4.3.3. Pump system power for each pumping system shall be the same as the proposed design; where the proposed design has no hot water pumps, the standard reference design pump power shall be 19 W/gpm (equal to a pump operating against a 60-foot head, 60-percent combined impeller and motor efficiency). The hot water system shall be modeled as primary only with continuous variable flow. Hot water pumps shall be modeled as riding the pump curve or with variable speed drives when required by Subsection C403.4.3.3.
- g. **Electric heat pump and boiler:** Water-source heat pumps shall be connected to a common heat pump water loop controlled to maintain temperatures between 60°F and 90°F. Heat rejection from the loop shall be provided by an axial fan closed-circuit evaporative fluid cooler with two-speed fans where required in Subsection C403.4.1. Heat addition to the loop shall be provided by a boiler that uses the same fuel as the proposed design and shall be natural draft. Where no boilers exist in the proposed design, the standard reference building boilers shall be fossil fuel. The standard reference design boiler plant shall be modeled with a single boiler where the standard reference design plant load is 600,000 Btu/h or less and with two equally sized boilers for plant capacities exceeding 600,000 Btu/h. Boilers shall be staged as required by the load. Piping losses shall not be modeled in either building model. Pump system power shall be the same as the proposed design; where the proposed design has no pumps, the standard reference design pump power shall be 22 W/gpm, which is equal to a pump operating against a 75-foot head, with a 65-percent combined impeller and motor efficiency. Loop flow shall be variable with flow shutoff at each heat pump when its compressor cycles off as required by Subsection C403.4.3.3. Loop pumps shall be modeled as riding the pump curve or with variable speed drives when required by Subsection C403.4.3.3.
- h. **Electric heat pump:** Electric air-source heat pumps shall be modeled with electric auxiliary heat. The system shall be controlled with a multistage space thermostat and an outdoor air thermostat wired to energize auxiliary heat only on the last thermostat stage and when outdoor air temperature is less than 40°F.
- i. **Constant volume:** Fans shall be controlled in the same manner as in the proposed design; i.e., fan operation whenever the space is occupied or fan operation cycled on calls for heating and cooling. Where the fan is modeled as cycling and the fan energy is included in the energy efficiency rating of the equipment, fan energy shall not be modeled explicitly.

TABLE C407.5.1(4)
NUMBER OF CHILLERS

TOTAL CHILLER PLANT CAPACITY	NUMBER OF CHILLERS
≤ 300 tons	1
> 300 tons, < 600 tons	2, sized equally
≥ 600 tons	2 minimum, with chillers added so that no chiller is larger than 800 tons, all sized equally

For SI: 1 ton = 3517 W.

TABLE C407.5.1(5)
WATER CHILLER TYPES

INDIVIDUAL CHILLER PLANT CAPACITY	ELECTRIC CHILLER TYPE	FOSSIL FUEL CHILLER TYPE
≤ 100 tons	Reciprocating	Single-effect absorption, direct fired
> 100 tons, < 300 tons	Screw	Double-effect absorption, direct fired
≥ 300 tons	Centrifugal	Double-effect absorption, direct fired

For SI: 1 ton = 3517 W.

C407.6.2 Input values. Where calculations require input values not specified by Sections C402, C403, C404 and C405, those input values shall be taken from an approved source.

C407.6.3 Exceptional calculation methods. Where the simulation program does not model a design, material or device of the proposed design, an exceptional calculation method shall be used where approved by the Building Official. Where there are multiple designs, materials or devices that the simulation program does not model, each shall be calculated separately and exceptional savings determined for each. The total exceptional savings shall not constitute more than half of the difference between the baseline building performance and the proposed building performance. Applications for approval of an exceptional method shall include all of the following:

1. Step-by-step documentation of the exceptional calculation method performed, detailed enough to reproduce the results.
2. Copies of all spreadsheets used to perform the calculations.
3. A sensitivity analysis of energy consumption where each of the input parameters is varied from half to double the value assumed.
4. The calculations shall be performed on a time step basis consistent with the simulation program used.
5. The performance rating calculated with and without the exceptional calculation method.

SECTION C408 SYSTEM COMMISSIONING

C408.1 General. This Section covers the commissioning of the building mechanical systems in Section C403 and electrical power and lighting systems in Section C405.

C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements. Prior to the final mechanical and plumbing inspections, the

licensed design professional, electrical engineer, mechanical engineer or approved agency shall provide evidence of mechanical systems commissioning and completion in accordance with the provisions of this Section.

Construction document notes shall clearly indicate provisions for commissioning and completion requirements in accordance with this Section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the Building Official upon request in accordance with Subsections C408.2.4 and C408.2.5.

Exceptions: The following systems are exempt:

1. Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Subsection C403.3 that serve individual dwelling units and sleeping units.

C408.2.1 Commissioning plan. A commissioning plan shall be developed by a licensed design professional, electrical engineer, mechanical engineer or approved agency and shall include the following items:

1. A narrative description of the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

C408.2.2 Air distribution system testing, adjusting and balancing. Construction documents shall require that a written balance report be provided to the owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 square feet (465 m²). Air distribution systems shall be tested, adjusted and balanced by a licensed engineer or a company or individual holding a current certification from a recognized testing and balancing agency organization in accordance with generally accepted engineering standards.

Exceptions:

1. Buildings with cooling or heating system capacities of 15 tons or less per system may be tested and balanced by a mechanical contractor licensed to design and install such system(s).
2. Buildings with cooling or heating system capacities of 65,000 Btu/h or less per system are exempt from the requirements of this Section.

C408.2.2.1 Air systems balancing. Air system balancing shall be accomplished in a manner to first minimize throttling losses; then for fans with fan system power greater than 1 hp, fan speeds shall be adjusted to meet design flow conditions. Balancing procedures shall be in accordance with the National Environmental Balancing Bureau (NEBB) Procedural Standards, the Associated Air Balance Council (AABC) National Standards, or equivalent procedures.

Exception: Damper throttling may be used for air system balancing with fan motors of 1 hp or less, or if throttling results in no greater than $\frac{1}{3}$ hp fan horsepower draw above that required if the fan speed were adjusted.

Notes:

1. Building envelope pressurization should be either neutral or positive to prevent infiltration of excess latent load.
2. Commercial kitchen hood exhaust cfm should be sized to prevent depressurization. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (7.5 kW) and larger.

C408.2.2.2 Hydronic systems balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and measuring flow. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the capability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions: The following equipment is not required to be equipped with a means for balancing or measuring flow:

1. Pumps with pump motors of 5 hp (3.7 kW) or less.

2. Where throttling results in no greater than 5 percent of the nameplate horsepower draw above that required if the impeller were trimmed.

C408.2.3 Functional performance testing. Functional performance testing specified in Subsections C408.2.3.1 through C408.2.3.3 shall be conducted.

C408.2.3.1 Equipment. Equipment functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed. Testing shall include all modes and sequence of operation, including under full-load, part-load and the following emergency conditions:

1. All modes as described in the sequence of operation.
2. Redundant or automatic back-up mode.
3. Performance of alarms.
4. Mode of operation upon a loss of power and restoration of power.

Exception: Unitary or packaged HVAC equipment listed in Tables C403.2.3(1) through C403.2.3(3) that do not require supply air economizers.

C408.2.3.2 Controls. HVAC and service water-heating control systems shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

C408.2.3.3 Economizers. Air economizers shall undergo a functional test to determine that they operate in accordance with manufacturer's specifications.

C408.2.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and certified by the licensed design professional, electrical engineer, mechanical engineer or approved agency and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this Section that have not been corrected at the time of report preparation.
2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
3. Climatic conditions required for performance of the deferred tests.

C408.2.4.1 Acceptance of report. Buildings, or portions thereof, shall not be considered acceptable for a final inspection pursuant to Subsection C104.3 until the

Building Official has received a letter of transmittal from the building owner acknowledging that the building owner or owner's authorized agent has received the Preliminary Commissioning Report.

C408.2.4.2 Copy of report. The Building Official shall be permitted to require that a copy of the Preliminary Commissioning Report be made available for review by the Building Official.

C408.2.5 Documentation requirements. The construction documents shall specify that the documents described in this Section be provided to the building owner or owner's authorized agent within 90 days of the date of receipt of the Certificate of Occupancy.

C408.2.5.1 Drawings. Construction documents shall include the location and performance data on each piece of equipment.

C408.2.5.2 Manuals. An operating and maintenance manual shall be provided and include all of the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Name and address of at least one service agency.
4. HVAC and service hot water controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in system programming instructions.
5. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
6. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
7. A schedule for inspecting and recalibrating all lighting controls.
8. A narrative of how each system is intended to operate, including recommended set points.

C408.2.5.3 System balancing report. A written report describing the activities and measurements completed in accordance with Subsection C408.2.2.

C408.2.5.4 Final commissioning report. A report of test procedures and results identified as "Final Commissioning Report" shall be delivered to the building owner or owner's authorized agent. The report shall be organized with mechanical system and service hot water system findings in separate sections to allow

independent review. The report shall include the following:

1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.
3. Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

Exception: Deferred tests that cannot be performed at the time of report preparation due to climatic conditions.

C408.3 Lighting system functional testing. Controls for automatic lighting systems shall comply with this Section.

C408.3.1 Functional testing. Prior to passing final inspection, the registered design professional shall provide evidence that the lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer's instructions. Functional testing shall be in accordance with Subsections C408.3.1.1 and C408.3.1.2 for the applicable control type.

C408.3.1.1 Occupant sensor controls. Where occupant sensor controls are provided, the following procedures shall be performed:

1. Certify that the occupant sensor has been located and aimed in accordance with manufacturer recommendations.
2. For projects with seven or fewer occupant sensors, each sensor shall be tested.
3. For projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent, but in no case less than one, of each combination shall be tested unless the Building Official or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail, all remaining identical combinations shall be tested.

For occupant sensor controls to be tested, verify the following:

- 3.1. Where occupant sensor controls include status indicators, verify correct operation.
- 3.2. The controlled lights turn off or down to the permitted level within the required time.
- 3.3. For auto-on occupant sensor controls, the lights turn on to the permitted level when an occupant enters the space.
- 3.4. For manual-on occupant sensor controls, the lights turn on only when manually activated.

- 3.5. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

C408.3.1.2 Time-switch controls. Where time-switch controls are provided, the following procedures shall be performed:

1. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.
2. Provide documentation to the owner of time-switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.
3. Verify the correct time and date in the time switch.
4. Verify that any battery back-up is installed and energized.
5. Verify that the override time limit is set to not more than 2 hours.
6. Simulate occupied condition. Verify and document the following:
 - 6.1. All lights can be turned on and off by their respective area control switch.
 - 6.2. The switch only operates lighting in the enclosed space in which the switch is located.

7. Simulate unoccupied condition. Verify and document the following:

- 7.1. Nonexempt lighting turns off.
- 7.2. Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shutoff occurs.

8. Additional testing as specified by the registered design professional.

C408.3.1.3 Daylight responsive controls. Where daylight responsive controls are provided, the following shall be verified:

1. Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels.
2. Daylight controlled lighting loads adjust to light level set points in response to available daylight.
3. The locations of calibration adjustment equipment are readily accessible only to authorized personnel.

C408.3.2 Documentation requirements. The construction documents shall specify that documents certifying that the installed lighting controls meet documented performance criteria of Section C405 are to be provided to the building owner within 90 days from the date of receipt of the Certificate of Occupancy.

CHAPTER 5 [CE]

EXISTING BUILDINGS

SECTION C501 GENERAL

C501.1 Scope. The provisions of this Chapter shall control the alteration, repair, addition and Change of Occupancy of existing buildings and structures.

C501.2 Existing buildings. Except as specified in this Chapter, this Code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this Code.

C501.3 Maintenance. Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this Code shall be maintained in conformance to the code edition under which installed. The owner or the owner's authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this Chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

C501.4 Compliance. Alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in the *EPCOT Building Code*; *EPCOT Fire Prevention Code*; *EPCOT Fuel Gas Code*; *EPCOT Mechanical Code*; *EPCOT Plumbing Code*; and NFPA 70.

C501.5 New and replacement materials. Except as otherwise required or permitted by this Code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not permit use of these materials in buildings of similar occupancy, purpose and location.

C501.6 Historic buildings. No provisions of this Code relating to the construction, repair, alteration, restoration and movement of structures, and Change of Occupancy shall be mandatory for historic buildings provided a report has been submitted to the Building Official and signed by a registered design professional, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic form, fabric or function of the building.

C501.7 Building systems and components. Thermal efficiency standards are set for the following building systems and components where new products are installed or replaced in existing buildings, and for which a permit must be obtained. New products shall meet the minimum efficiencies

allowed by this Code for the following systems and components:

Heating, ventilating or air-conditioning systems;
Service water or pool heating systems;
Lighting systems; and
Replacement fenestration.

Exceptions:

1. Where part of a functional unit is repaired or replaced. For example, replacement of an entire HVAC system is not required because a new compressor or other part does not meet code when installed with an older system.
2. If the unit being replaced is itself a functional unit, such as a condenser, it does not constitute a repair. Outdoor and indoor units that are not designed to be operated together must meet the U.S. Department of Energy certification requirements contained in Subsection R303.1.2. Matched systems are required; this match may be verified by any one of the following means:
 - a. AHRI data
 - b. Accredited laboratory
 - c. Manufacturer's letter
 - d. Letter from registered P.E. State of Florida
3. Where existing components are utilized with a replacement system, such as air distribution system ducts or electrical wiring for lights, such components or controls need not meet code if meeting code would require that component's replacement.
4. Replacement equipment that would require extensive revisions to other systems, equipment or elements of a building where such replacement is a like-for-like replacement, such as through-the-wall condensing units and PTACs, chillers and cooling towers in confined spaces.

C501.7.1 Existing equipment efficiencies. Existing cooling and heating equipment in residential applications need not meet the minimum equipment efficiencies, including system sizing and duct sealing.

SECTION C502 ADDITIONS

C502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of this Code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this Code. Additions

shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this Code if the addition alone complies or if the existing building and addition comply with this Code as a single building. Additions shall comply with Subsection C502.2.

Additions complying with ANSI/ASHRAE/IESNA 90.1, need not comply with Sections C402, C403, C404 and C405.

C502.2 Prescriptive compliance. Additions shall comply with Subsections C502.2.1 through C502.2.6.2.

C502.2.1 Vertical fenestration. New vertical fenestration area that results in a total building fenestration area less than or equal to that specified in Subsection C402.4.1 shall comply with Subsection C402.4. Additions with vertical fenestration that result in a total building fenestration area greater than Subsection C402.4.1 or additions that exceed the fenestration area greater than Subsection C402.4.1 shall comply with Subsection C402.4.1.1 for the addition only. Additions that result in a total building vertical glass area exceeding that specified in Subsection C402.4.1.1 shall comply with Section C407.

C502.2.2 Skylight area. New skylight area that results in a total building fenestration area less than or equal to that specified in Subsection C402.4.1 shall comply with Subsection C402.4. Additions with skylight area that result in a total building skylight area greater than Subsection C402.4.1 or additions that exceed the skylight area shall comply with Subsection C402.4.1.2 for the addition only. Additions that result in a total building skylight area exceeding that specified in Subsection C402.4.1.2 shall comply with Section C407.

C502.2.3 Building mechanical systems. New mechanical systems and equipment that are part of the addition and serve the building heating, cooling and ventilation needs shall comply with Section C403.

C502.2.4 Service water-heating systems. New service water-heating equipment, controls and service water heating piping shall comply with Section C404.

C502.2.5 Pools and inground permanently installed spas. New pools and inground permanently installed spas shall comply with Subsection C404.9.

C502.2.6 Lighting power and systems. New lighting systems that are installed as part of the addition shall comply with Section C405.

C502.2.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Subsection C405.4.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C502.2.6.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Subsection C405.5.1 for the addition alone, or the existing building and the addition shall comply as a single building.

SECTION C503 ALTERATIONS

C503.1 General. Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less conforming to the provisions of this Code than the existing building or structure was prior to the alteration. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this Code as those provisions relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this Code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems.

Alterations complying with ANSI/ASHRAE/IESNA 90.1, need not comply with Sections C402, C403, C404 and C405.

Exception: The following alterations need not comply with the requirements for new construction, provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided the code does not require the glazing or fenestration to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Roof recover.
6. Air barriers shall not be required for roof recover and roof replacement where the alterations or renovations to the building do not include alterations, renovations or repairs to the remainder of the building envelope.
7. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

C503.2 Change in space conditioning. Any nonconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this Code.

C503.3 Building envelope. New building envelope assemblies that are part of the alteration shall comply with Subsections C402.1 through C402.5.

C503.3.1 Roof replacement. Roof replacements shall comply with Table C402.1.3 or C402.1.4 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck.

C503.3.2 Vertical fenestration. The addition of vertical fenestration that results in a total building fenestration area less than or equal to that specified in Subsection C402.4.1 shall comply with Subsection C402.4. The addition of vertical fenestration that results in a total building fenestration

area greater than Subsection C402.4.1 shall comply with Subsection C402.4.1.1 for the space adjacent to the new fenestration only. Alterations that result in a total building vertical glass area exceeding that specified in Subsection C402.4.1.1 shall comply with Section C407.

C503.3.3 Skylight area. The addition of skylight area that results in a total building skylight area less than or equal to that specified in Subsection C402.4.1 shall comply with Subsection C402.4. The addition of skylight area that results in a total building skylight area greater than Subsection C402.4.1 shall comply with Subsection C402.4.1.2 for the space adjacent to the new skylights. Alterations that result in a total building skylight area exceeding that specified in Subsection C402.4.1.2 shall comply with Section C407.

C503.4 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Sections C403.

C503.4.1 Economizers. New cooling systems that are part of alteration shall comply with Subsection C403.3.

C503.5 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Section C404.

C503.6 Lighting systems. New lighting systems that are part of the alteration shall comply with Section C405.

Exception: Alterations that replace less than 10 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

SECTION C504 REPAIRS

C504.1 General. Buildings and structures, and parts thereof, shall be repaired in compliance with Subsection C501.3 and this Section. Work on nondamaged components that is necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this Chapter. Routine maintenance required by Subsection C501.3, ordinary repairs exempt from permit and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this Section.

Where a building was constructed to comply with ANSI/ASHRAE/IESNA 90.1, repairs shall comply with the standard and need not comply with Sections C402, C403, C404 and C405.

C504.2 Application. For the purposes of this Code, the following shall be considered repairs:

1. Glass-only replacements in an existing sash and frame.
2. Roof repairs.
3. Air barriers shall not be required for roof repair where the repairs to the building do not include alterations,

renovations or repairs to the remainder of the building envelope.

4. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided that an existing vestibule that separates a conditioned space from the exterior shall not be removed.
5. Repairs where only the bulb, the ballast or both within the existing luminaires in a space are replaced, provided that the replacement does not increase the installed interior lighting power.

SECTION C505 CHANGE OF OCCUPANCY OR USE

C505.1 General. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this Code. Where the use in a space changes from one use in Table C405.4.2(1) or C405.4.2(2) to another use in Table C405.4.2(1) or C405.4.2(2), the installed lighting wattage shall comply with Subsection C405.4.

CHAPTER 6 [CE]

REFERENCED STANDARDS

This Chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 106.

AABC

Associated Air Balance Council
1518 K Street, Suite 503
Washington, DC 20005

Standard reference number	Title	Referenced in code section number
AABC, 1989	Associated Air Balance Council National Standards.	C408.2.2.1

AAMA

American Architectural Manufacturers Association
1827 Walden Office Square
Suite 550
Schaumburg, IL 60173-4268

Standard reference number	Title	Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A C440—11	North American Fenestration Standard/ Specifications for Windows, Doors and Unit Skylights	Table C402.5.2

ACCA

Air Conditioning Contractors of America
2800 Shirlington Road, Suite 300
Arlington, VA 22206

Standard reference number	Title	Referenced in code section number
ACCA Manual D-1995	Residential Duct Systems.	C403.2.9.5
ACCA Manual N-2005	Commercial Load Calculation	C403.2.1
ANSI/ASHRAE/ ACCA 183-2007	Peak Cooling and Heating Load Calculations in Buildings Except Low-rise Residential Buildings	C403.2.1

ADC

Air Duct Council
1901 N. Roselle Rd., Suite 800
Schaumburg, IL 60195

Standard reference number	Title	Referenced in code section number
ADC 2003	Flexible Duct Performance & Installation Standards, Fourth Edition.	Table C403.2.9.2

REFERENCED STANDARDS

AHAM

Association of Home Appliance Manufacturers
1111 19th Street, NW, Suite 402
Washington, DC 20036

Standard reference number	Title	Referenced in code section number
ANSI/AHAM RAC-1—2008	Room Air Conditioners	Table C403.2.3(3)
AHAM HRF-1—2007	Energy, Performance and Capacity of Household Refrigerators, Refrigerator-Freezers and Freezers	Table C403.2.14.1

AHRI

Air-Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

Standard reference number	Title	Referenced in code section number
ISO/AHRI/ASHRAE 13256-1 (2011)	Water-to-Air and Brine-to-Air Heat Pumps— Testing and Rating for Performance	Table C403.2.3(2)
ISO/AHRI/ASHRAE 13256-2 (2011)	Water-to-Water and Brine-to-Water Heat Pumps — Testing and Rating for Performance	Table C403.2.3(2)
210/240—08 with Addenda 1 and 2	Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment	Table C403.2.3(1), Table C403.2.3(2)
310/380—04 (CSA-C744-04)	Standard for Packaged Terminal Air Conditioners and Heat Pumps	Table C403.2.3(3)
340/360—2007 with Addendum 2	Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment	Table C403.2.3(1), Table C403.2.3(2)
365(I-P)—09	Commercial and Industrial Unitary Air-Conditioning Condensing Units	Table C403.2.3(1), Table C403.2.3(6)
390—03	Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps	Table C403.2.3(3)
400—2001	Liquid to Liquid Heat Exchangers with Addendum 1 and 2	Table C403.2.3(10)
440—2008	Performance Rating of Room Fan Coils	C403.2.10
460—2005	Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers	Table C403.2.3(8)
550/590—2011 With Addendum 1	Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle	C403.2.3.1, Table C403.2.3(7)
560—00	Absorption Water Chilling and Water Heating Packages.	Table C403.2.3(7)
1160 (I-P) —09	Performance Rating of Heat Pump Pool Heaters	Table C404.2
1200-2010	Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets	C403.2.14, Table C403.2.14(1), Table C403.2.14(2)
1230-2010	Performance Rating of Variable Refrigerant Flow (VRF) Multi-split Air-conditioning and Heat Pump Equipment with Addendum 1	Table C403.2.3(11)

AMCA

Air Movement and Control Association International
30 West University Drive
Arlington Heights, IL 60004-1806

Standard reference number	Title	Referenced in code section number
205—12	Energy Efficiency Classification for Fans	C403.2.12.3
220—08 (R2012)	Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating.	C402.5.7
500D—12	Laboratory Methods for Testing Dampers for Rating	C403.2.4.3

ANSI

American National Standards Institute
25 West 43rd Street
4th Floor
New York, NY 10036

Standard reference number	Title	Referenced in code section number
A 112.18.1M—1999	Finished and Rough Brass Plumbing Fixture Fittings	C404.12.1
Z21.10.3/CSA 4.3—11	Gas Water Heaters, Volume III—Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating Tank and Instantaneous	Table C404.2
Z21.47/CSA 2.3—12	Gas-fired Central Furnaces	Table C403.2.3(4)
Z83.8/CSA 2.6—09	Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-fired Duct Furnaces	Table C403.2.3(4)

APSP

The Association of Pool & Spa Professionals
2111 Eisenhower Avenue, Suite 500
Alexandria, VA 22314

Standard reference number	Title	Referenced in code section number
ANSI/APSP/ICC 14-14	American National Standard for Portable Electric Spa Energy Efficiency	C404.10

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329-2305

Standard reference number	Title	Referenced in code section number
ASHRAE 127-2007	Method of Testing for Rating Computer	Table C403.2.3(9)
ANSI/ASHRAE Standard 55—1992	Thermal Environmental Conditions for Human Occupancy	C403.5.3
ANSI/ASHRAE/ACCA Standard 183—2007 (RA2011)	Peak Cooling and Heating Load Calculations in Buildings, Except Low-rise Residential Buildings	C403.2.1
ASHRAE—2008	HVAC Systems and Equipment Handbook	C403.2.1
ASHRAE—2012	ASHRAE HVAC Systems and Equipment Handbook	C403.2.1
ISO/AHRI/ASHRAE 13256-1 (2011)	Water-to-Air and Brine-to-Air Heat Pumps—Testing and Rating for Performance	Table C403.2.3(2)
ISO/AHRI/ASHRAE 13256-2 (2011)	Water-to-Water and Brine-to-Water Heat Pumps—Testing and Rating for Performance	Table C403.2.3(2)
ANSI/ASHRAE/IESNA 90.1—2013	Energy Standard for Buildings Except Low-rise Residential Buildings, excluding section 9.4.1.1(g)	C304.1.1, C304.3.1.4, C304.3.2.1, C304.3.2.2, C401.2, C405.6.1, C406.2, C502.1, C504.1
140—2011	Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs	C407.6.1
146—2011	Testing and Rating Pool Heaters	Table C404.2

ASME

American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990

Standard reference number	Title	Referenced in code section number
ASME A17.1/CSA B44—2013	Safety Code for Elevators and Escalators	C405.9.2

REFERENCED STANDARDS

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

Standard reference number	Title	Referenced in code section number
C36/C36M—03	Standard Specification for Gypsum Wallboard	202
C90—13	Specification for Load-bearing Concrete Masonry Units	Table C401.3, C304.1.1
C177—04	Test Method for Steady-state Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-hot-plate Apparatus	C304.2.1
C236—89 (1993e1)	Test Method for Steady-state Thermal Performance of Building Assemblies by Means of a Guarded Hot Box	C304.2.1
C 518—04	Test Method for Steady-state Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	C304.2.1
C1363—05	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	C304.2.2
C1363—11	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	C303.1.4.1, Table C402.1.4
C1371—04a(2010)e1	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers	Table C402.3
C1549—09	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using A Portable Solar Reflectometer	Table C402.3
D1003—11e1	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics	C402.4.2.2
D2412—02(2008)	Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Pipe Loading	Table C403.2.9.2
E84—09	Test Method for Surface Burning Characteristics of Building Materials	202, C403.2.9.3.7
E283—04	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen	C402.5.1.2.2, Table C402.5.2, C402.5.8
E408—71(2008)	Test Methods for Total Normal Emittance of Surfaces Using Inspection-meter Techniques	Table C402.3
E779—10	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization	C402.5
E903—96	Standard Test Method Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres (Withdrawn 2005)	Table C402.3
E1677—11	Standard Specification for an Air-retarder (AR) Material or System for Low-rise Framed Building Walls	C402.5.1.2.2
E1918—06	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-sloped Surfaces in the Field	Table C402.3
E1980—11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-sloped Opaque Surfaces	Table C402.3, C402.3.2
E2178—13	Standard Test Method for Air Permanence of Building Materials	C402.5.1.2.1
E2357—11	Standard Test Method for Determining Air Leakage of Air Barriers Assemblies	C402.5.1.2.2

CRRC

Cool Roof Rating Council
449 15th Street, Suite 400
Oakland, CA 94612

Standard reference number	Title	Referenced in code section number
ANSI/CRRC-1—2012	CRRC-1 Standard	Table C402.3, C402.3.2, C402.3.2.1, Table C407.5.1(1)

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

Standard reference number	Title	Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A440—11	North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights	Table C402.5.2
CSA B55.1—2012	Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Units . . .	C404.8
CSA B55.2—2012	Drain Water Heat Recover Units	C404.8

CTI

Cooling Technology Institute
P. O. Box 681807
Houston, TX 77268

Standard reference number	Title	Referenced in code section number
ATC 105 (00)	Acceptance Test Code for Water Cooling Tower	Table C403.2.3(8)
ATC 105S—11	Acceptance Test Code for Closed Circuit Cooling Towers	Table C403.2.3(8)
ATC 106—11	Acceptance Test For Mechanical Draft Evaporative Vapor Condensers	Table C403.2.3(8)
STD 201—11	Standard for Certification of Water Cooling Towers Thermal Performances	Table C403.2.3(8)

DASMA

Door & Access Systems Manufacturers Association
1300 Sumner Avenue
Cleveland, OH 44115-2851

Standard reference number	Title	Referenced in code section number
105—92 (R2004)—13	Test Method for Thermal Transmittance and Air Infiltration of Garage Doors	C303.1.3, Table C402.5.2

DOE

U.S. Department of Energy
c/o Superintendent of Documents
1000 Independence Avenue SW
Washington, DC 20585

Standard reference number	Title	Referenced in code section number
10 CFR, Part 430—1998	Energy Conservation Program for Consumer Products: Test Procedures and Certification and Enforcement Requirement for Plumbing Products; and Certification and Enforcement Requirements for Residential Appliances; Final Rule	Table C403.2.3(4), Table C403.2.3(5), Table C404.2
10 CFR, Part 430, Subpart B, Appendix N—1998	Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers	C202
10 CFR, Part 431—2004	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards; Final Rules	Table C403.2.3(5), C405.7, C405.8, Table C405.8
10 CFR 431 Subpart B App B	Uniform Test Method for Measuring Nominal Full Load Efficiency of Electric Motors	C403.4.4.4, Table C405.8(1), Table C405.8(2), Table C405.8(3), C405.8(4)
NAECA 87—(88)	National Appliance Energy Conservation Act 1987 [(Public Law 100-12 (with Amendments of 1988-P.L. 100-357))]	Tables C403.2.3(1), C403.2.3(2), C403.2.3(4)

REFERENCED STANDARDS

EPCOT Codes

Reedy Creek Improvement District
P.O. Box 10170
Lake Buena Vista, FL 32830

Standard reference number	Title	Referenced in code section number
EBC—Sixteenth Edition (2018)	EPCOT Building Code	C201.3, C202, C303.2, C402.5.3, C402.5.4, C501.4
EFGC—Thirteenth Edition (2018)	EPCOT Fuel Gas Code	C201.3, C501.4
EFPC—Tenth Edition (2018)	EPCOT Fire Prevention Code	C201.3, C501.4
EMC—Fourteenth Edition (2018)	EPCOT Mechanical	C201.3, C402.5.3, C403.2.4.3, C403.2.6, C403.2.6.1, C403.2.6.2, C403.2.7, C403.2.9, Table C403.2.9.2, C403.4.1.1, C403.4.4, C403.4.4.6, C406.6, C501.4
EPC—Fifteenth Edition (2018)	EPCOT Plumbing Code	C201.3, C501.4

Florida Codes

Building Codes and Standards Office
Florida Department of Business and Professional Regulation
1940 N Monroe Street, Suite 90A
Tallahassee, FL 32399-0772

Standard reference number	Title	Referenced in code section number
FFPC—Sixth Edition (2017)	Florida Fire Prevention Code	C201.3
FS	Florida Statutes	C103.1.1.1.2, C103.1.1.2

IEEE

Institute of Electrical and Electronic Engineers Inc.
3 Park Avenue, 17th Floor
New York, NY 10016

Standard reference number	Title	Referenced in code section number
IEEE 515.1—2012	IEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications	C404.6.2

IES

Illuminating Engineering Society
120 Wall Street, 17th Floor
New York, NY 10005-4001

Standard reference number	Title	Referenced in code section number
ANSI/ASHRAE/IESNA 90.1—2013	Energy Standard for Buildings Except Low-rise Residential Buildings, excluding section 9.4.1.1(g)	C401.2, Table C402.1.3, Table C402.1.4, C406.2, C502.1, C503.1, C504.1

ISO

International Organization for Standardization
Chemin de Blandonnet 8
CP 401
1214 Vernier
Geneva, Switzerland

Standard reference number	Title	Referenced in code section number
ISO/AHRI/ASHRAE 13256-1 (2011)	Water-to-Air and Brine-to-air Heat Pumps -Testing and Rating for Performance.	Table C403.2.3(2)

ISO-continued

ISO/AHRI/ASHRAE
13256-2(2011)

Water-to-Water and Brine-to-Water Heat Pumps -Testing and Rating
for Performance C403.2.3(2)

NAIMA

North American Insulation Manufacturers Association
11 Canal Center Plaza, Suite 103
Alexandria, VA 22314

Standard reference number	Title	Referenced in code section number
NAIMA 2002	Fibrous Glass Duct Construction Standards, Fifth Edition	Table C403.2.9.2

NEBB

National Environmental Balancing Bureau
8575 Grovemont Circle
Gaithersburg, MD 20877-4121

Standard reference number	Title	Referenced in code section number
NEBB, 2005	Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition	C408.2.2.1

NEMA

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Arlington, VA 22209

Standard reference number	Title	Referenced in code section number
MG1—1993	Motors and Generators.	C202

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471

Standard reference number	Title	Referenced in code section number
70—14	National Electrical Code	C501.4

NFRC

National Fenestration Rating Council, Inc.
6305 Ivy Lane, Suite 140
Greenbelt, MD 20770

Standard reference number	Title	Referenced in code section number
100—2009	Procedure for Determining Fenestration Products <i>U</i> -factors—Second Edition	C303.1.3, C402.2.2
200—2009	Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence—Second Edition	C303.1.3, C402.4.1.1
400—2009	Procedure for Determining Fenestration Product Air Leakage—Second Edition	Table C402.5.2

REFERENCED STANDARDS

SMACNA

Sheet Metal and Air Conditioning Contractors' National Association, Inc.
4021 Lafayette Center Drive
Chantilly, VA 20151-1219

Standard reference number	Title	Referenced in code section number
SMACNA—2012	HVAC Air Duct Leakage Test Manual 2nd Edition.	Table C403.2.9.2, C403.2.9.3.7

SPRI

Single Ply Roofing Industry
465 Waverly Oaks Road, Suite 421
Waltham, MA 02452

Standard reference number	Title	Referenced in code section number
ANSI/SPRI VF-1 2010	External Fire Design Standard for Vegetative Roofs	C407.5.2.4.1

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062-2096

Standard reference number	Title	Referenced in code section number
181—05	Standard for Factory-made Air Ducts and Air Connectors— with Revisions through December 1998.	Table C403.2.9.2
181A—05	Closure Systems for Use with Rigid Air Ducts and Air Connectors— with Revisions through December 1998.	Table C403.2.9.2, C403.2.9.3.7
181B—05	Closure Systems for Use with Flexible Air Ducts and Air Connectors— with Revisions through May 2000	Table C403.2.9.2, C403.2.9.3.7
710—12	Exhaust Hoods for Commercial Cooking Equipment	C403.2.8
723—03	Standard for Test for Surface Burning Characteristics of Building Materials	C403.2.9.3.7
727—06	Oil-fired Central Furnaces—with Revisions through April 2010.	Table C403.2.3(4)
731—95	Oil-fired Unit Heaters—with Revisions through August 2012	Table C403.2.3(4)
1784—01	Air Leakage Tests of Door Assemblies—with Revisions through July 2009	C402.5.3

US-FTC

United States-Federal Trade Commission
600 Pennsylvania Avenue NW
Washington, DC 20580

Standard reference number	Title	Referenced in code section number
CFR Title 16 (May 31, 2005)	R-value Rule	C303.1.4

WDMA

Window and Door Manufacturers Association
2025 M Street NW, Suite 800
Washington, DC 20036-3309

Standard reference number	Title	Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A440—11	North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights	Table C402.5.2

APPENDIX CA

FORMS

EPCOT ENERGY EFFICIENCY CODE FOR BUILDING CONSTRUCTION CHAPTER C4—COMMERCIAL ENERGY EFFICIENCY					
Form C402-2017 ALTERATIONS, RENOVATIONS and BUILDING SYSTEMS					
Project Name:			Climate Zone:		
Address:			Occupancy type:		
City, Zip Code:			Alteration <input type="checkbox"/> Renovation <input type="checkbox"/> Building System <input type="checkbox"/>		
Builder:			Building Permit No.:		
Owner:			Permitting Office:		
BUILDING ENVELOPE INFORMATION (Where changed)					
Envelope Component	Description	Requirement		Efficiency	
		Location	Unit	Required	Installed
Roof type		Table C402.1.4 or Table C402.1.3	\leq U-factor or \geq R-value		
Roof reflectance/Emittance (low slope roofs)		Table C402.3	\geq Solar reflectance, \geq Thermal emittance		
Wall type, above grade		Table C402.1.4 or Table C402.1.3	\leq U-factor or \geq R-value		
Wall, below grade					
Floor type					
Vertical fenestrations		Table C402.4	\leq U-factor		
			\leq SHGC		
Skylights			\leq U-factor		
			\leq SHGC		
BUILDING SYSTEMS INFORMATION [for HVAC, service hot water or pool heating, lighting systems and replacement fenestration (C501.7)]					
System	Type (describe system)	Requirement		Efficiency	
		Location	Unit	Required	Installed
Air-conditioning system		Tables C403.2.3 (1-3, 6-8, 9-11)	SEER or EER, IEER		
Heating system		Tables C403.2.3 (2-6)	HSPF or COP AFUE, E_t or E_c		
Ventilation/air handling system		Tables C403.2.12.1(1-2)	Fan power (cfm)		
Ducts	Location:	Table C403.2.9.1	R-value		
Piping	Fluid design operating temp:	Table C403.2.10	Inches		
Hot water		Table C404.2	EF, E_p , COP		
Lighting	Space types: (append list)	Table C405.4.2 (1 or 2)	Lighting power density		
Fenestrations: Enter information in BUILDING ENVELOPE INFORMATION box above.					
Other:					
COMPLIANCE IS BY ANSI/ASHRAE/IESNA 90.1 <input type="checkbox"/> (Submit alternate form or append documents as needed)					
I hereby certify that the plans and specifications covered by the calculation are in compliance with the EPCOT Energy Efficiency Code for Building Construction. PREPARED BY: _____ DATE: _____			Review of plans and specifications covered by this calculation indicates compliance with the EPCOT Energy Code for Building Construction. Before construction is completed, this building will be inspected for compliance in accordance with Section 553.908, F.S. BUILDING OFFICIAL: _____ DATE: _____		
I hereby certify that this building is in compliance with the EPCOT Energy Efficiency Code for Building Construction. OWNER/AGENT: _____ DATE: _____					

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CHAPTER 1 [RE]

SCOPE AND ADMINISTRATION

PART 1—SCOPE AND APPLICATION

SECTION R101 SCOPE AND GENERAL REQUIREMENTS

R101.1 Title. This Code shall be known as the *EPCOT Energy Efficiency Code for Building Construction* and shall be cited as such. It is referred to herein as “this Code.”

R101.2 Scope. This Code applies to residential buildings and the building sites and associated systems and equipment.

R101.3 Intent. This Code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This Code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This Code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

R101.4 Applicability. Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

R101.4.1 Mixed occupancy. Where a building includes both residential and commercial occupancies, each occupancy shall be separately considered and meet the applicable provisions of this Code.

R101.4.2 Exempt buildings. Buildings exempt from the provisions of this Code include existing buildings except those considered renovated buildings, changes of occupancy type or previously unconditioned buildings to which comfort conditioning is added. Exempt buildings include those specified in Subsections R101.4.2.1 through R101.4.2.4.

R101.4.2.1 Federal standards. Any building for which federal mandatory standards preempt state energy codes.

R101.4.2.2 Hunting or recreational buildings < 1,000 square feet. Any building of less than 1,000 square feet (93 m²) whose primary use is not as a principal residence and which is constructed and owned by a natural person for hunting or similar recreational purposes is exempt from this Code; however, no such person may build more than one exempt building in any 12-month period.

R101.4.2.3 Historic buildings. Any building meeting the criteria for historic buildings as defined in Chapter 2 of this Code.

R101.4.2.4 Low-energy buildings as described in Subsection R402.1. Such buildings shall not contain electrical, plumbing or mechanical systems that have been designed to accommodate the future installation of heating or cooling equipment.

R101.5 Compliance. Residential buildings shall meet the Residential Provisions of this Code. Commercial buildings shall meet the Commercial Provisions of this Code.

R101.5.1 Compliance materials. The Florida Building Commission shall approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this Code. Commission approved code compliance demonstration forms can be found in Table R101.5.1.

TABLE R101.5.1
INDEX TO CODE COMPLIANCE FORMS

FORM	WHERE FOUND
Form R402	Appendix RD
Florida REScheck	Computer printout
Form R405	Commission approved software printout

R101.5.1.1 Residential ≤ 3 stories.

R101.5.1.1.1 Building thermal envelope alternative. An accurately completed Residential Building Form R402 shall be submitted to the Building Official to demonstrate code compliance by this method. Alternatively, a Florida REScheck computer printout may be submitted to demonstrate compliance by Sections R402, R403 and R404.

R101.5.1.1.2 Simulated performance alternative. An accurately completed Residential Building Form R405 (generated by Commission approved software) demonstrating that code compliance has been achieved shall be submitted to the Building Official for compliance by Section R405.

R101.5.1.2 Commercial and residential > 3 stories. See *EPCOT Energy Efficiency Code for Building Construction*— Commercial Provisions.

SECTION R102 ALTERNATIVE MATERIALS, DESIGN AND METHODS OF CONSTRUCTION AND EQUIPMENT

R102.1 General. The provisions of this Code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this Code, provided that any such alternative has been approved. The Building Official shall be permitted to approve an alternative material, design or method of construction where the Building Official finds that the proposed

design is satisfactory and complies with the intent of the provisions of this Code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this Code.

R102.1.1 Above code programs. The Building Official or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this Code. Buildings approved in writing by such an energy-efficiency program shall be considered in compliance with this Code. The requirements identified as “mandatory” in Chapter 4 shall be met.

PART 2—ADMINISTRATION AND ENFORCEMENT

SECTION R103 CONSTRUCTION DOCUMENTS

R103.1 General. Construction documents, technical reports and other supporting data shall be submitted in one or more sets with each application for a permit. The construction documents and technical reports shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the Building Official is authorized to require necessary construction documents to be prepared by a registered design professional.

Exception: The Building Official is authorized to waive the requirements for construction documents or other supporting data if the Building Official determines they are not necessary to confirm compliance with this Code.

R103.1.1 Compliance certification.

R103.1.1.1 Code compliance demonstration.

R103.1.1.1.1 Residential. No license or registration is required to prepare the code compliance form for single-family residential dwellings, duplexes and townhouses.

R103.1.1.1.2 Commercial and multiple-family residential. Completion of procedures demonstrating compliance with this Code for multiple-family residential buildings shall be in accordance with the provisions of Section 481.229, *Florida Statutes*, or Section 471.003, *Florida Statutes*.

Exception: Where HVAC systems are nominal 15 tons per system or smaller, commercial building energy raters certified in accordance with Section 553.99, *Florida Statutes*, or as authorized by *Florida Statutes*, may prepare the code compliance form.

R103.1.1.2 Code compliance certification. The building’s owner, the owner’s architect or other authorized agent legally designated by the owner shall certify that the building is in compliance with the code, as per Section 553.907, *Florida Statutes*, prior to receiving the permit to begin construction or renovation.

R103.1.1.2.1 Reporting to entity representing the Florida Building Commission. A reporting form shall be submitted to the local building department by the owner or owner’s agent with the submittal certifying compliance with this Code. Reporting forms shall be a copy of the front page of the form applicable for the code chapter under which compliance is demonstrated.

R103.1.1.2.1.1 Reporting schedule. It shall be the responsibility of the local Building Official to forward the reporting section of the proper form to the entity representing the Florida Building Commission on a quarterly basis.

R103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted where approved by the Building Official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Insulation materials and their *R*-values.
2. Fenestration *U*-factors and solar heat gain coefficients (SHGC).
3. Area-weighted *U*-factor and solar heat gain coefficients (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water-heating system and equipment types, sizes and efficiencies.
6. Equipment and system controls.
7. Duct sealing, duct and pipe insulation and location.
8. Air sealing details.

R103.2.1 Building thermal envelope depiction. The building’s thermal envelope shall be represented on the construction documents.

R103.3 Examination of documents. The Building Official shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this Code and other pertinent laws or ordinances. The Building Official is authorized to utilize a registered design professional, or other approved entity not affiliated with the building design or construction, in conducting the review of the plans and specifications for compliance with the code.

R103.3.1 Approval of construction documents. When the Building Official issues a permit where construction documents are required, the construction documents shall be endorsed in writing and stamped “Reviewed for Code Compliance.” Such approved construction documents shall not be changed, modified or altered without authorization from the Building Official. Work shall be done in accordance with the approved construction documents.

One set of construction documents so reviewed shall be retained by the Building Official. The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the Building Official or a duly authorized representative.

R103.3.2 Previous approvals. This Code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this Code and has not been abandoned.

R103.3.3 Phased approval. The Building Official shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or approved, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this Code. The holders of such permit shall proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

R103.4 Amended construction documents. Work shall be installed in accordance with the approved construction documents, and any changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.

R103.5 Retention of construction documents. One set of approved construction documents shall be retained by the Building Official for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

SECTION R104 INSPECTIONS

R104.1 General. Construction or work for which a permit is required shall be subject to inspection by the Building Official or his or her designated agent, and such construction or work shall remain accessible and exposed for inspection purposes until approved. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Neither the Building Official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this Code.

R104.2 Required inspections. The Building Official or his or her designated agent, upon notification, shall make the inspections set forth in Subsections R104.2.1 through R104.2.5.

R104.2.1 Footing and foundation inspection. Inspections associated with footings and foundations shall verify compliance with the code as to *R*-value, location, thickness, depth of burial and protection of insulation as required by the code and approved plans and specifications.

R104.2.2 Framing and rough-in inspection. Inspections at framing and rough-in shall be made before application

of interior finish and shall verify compliance with the code as to types of insulation and corresponding *R*-values and their correct location and proper installation; fenestration properties (*U*-factor and SHGC) and proper installation; and air leakage controls as required by the code and approved plans and specifications.

R104.2.3 Plumbing rough-in inspection. Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding *R*-values and protection, and required control.

R104.2.4 Mechanical rough-in inspection. Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding *R*-value, system air leakage control, programmable thermostats, dampers, whole-house ventilation, and minimum fan efficiency.

Exception: Systems serving multiple dwelling units shall be inspected in accordance with Subsection C104.2.4.

R104.2.5 Final inspection. The building shall have a final inspection and shall not be occupied until approved. The final inspection shall include verification of the installation of all required building systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

R104.3 Reinspection. A building shall be reinspected when determined necessary by the Building Official.

R104.4 Approved inspection agencies. The Building Official is authorized to accept inspection reports in whole or in part from either individuals as defined in Section 553.993(5) or (7), *Florida Statutes* or third-party inspection agencies not affiliated with the building design or construction, provided such agencies are approved as to qualifications and reliability relevant to the building components and systems they are inspecting.

R104.5 Inspection requests. It shall be the duty of the holder of the permit or their duly authorized agent to notify the Building Official when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this Code.

R104.6 Reinspection and testing. Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made to achieve compliance with this Code. The work or installation shall then be resubmitted to the Building Official for inspection and testing.

R104.7 Approval. After the prescribed tests and inspections indicate that the work complies in all respects with this Code, a notice of approval shall be issued by the Building Official.

R104.7.1 Revocation. The Building Official is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this Code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise, or portion thereof is in vio-

SCOPE AND ADMINISTRATION

lation of any ordinance or regulation or any of the provisions of this Code.

SECTION R105 VALIDITY

R105.1 General. If a portion of this Code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this Code.

SECTION R106 REFERENCED STANDARDS

R106.1 Referenced codes and standards. The codes and standards referenced in this Code shall be those listed in Chapter 5, and such codes and standards shall be considered as part of the requirements of this Code to the prescribed extent of each such reference and as further regulated in Subsections R106.1.1 and R106.1.2.

R106.1.1 Conflicts. Where conflicts occur between provisions of this Code and referenced codes and standards, the provisions of this Code shall apply.

R106.1.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this Code, the provisions of this Code, as applicable, shall take precedence over the provisions in the referenced code or standard.

R106.2 Application of references. References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this Code.

R106.3 Other laws. The provisions of this Code shall not be deemed to nullify any provisions of local, state or federal law.

SECTION R107 FEES RESERVED

SECTION R108 STOP WORK ORDER

R108.1 Authority. Where the Building Official finds any work regulated by this Code being performed in a manner either contrary to the provisions of this Code or dangerous or unsafe, the Building Official is authorized to issue a stop work order.

R108.2 Issuance. The stop work order shall be in writing and shall be given to the owner of the property involved, to the owner's authorized agent, or to the person doing the work. Upon issuance of a stop work order, the cited work shall immediately cease. The stop work order shall state the reason for the order and the conditions under which the cited work will be permitted to resume.

R108.3 Emergencies. Reserved.

R108.4 Failure to comply. Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be subject to penalties as prescribed by law.

SECTION R109 BOARD OF APPEALS RESERVED

CHAPTER 2 [RE] DEFINITIONS

SECTION R201 GENERAL

R201.1 Scope. Unless stated otherwise, the following words and terms in this Code shall have the meanings indicated in this Chapter.

R201.2 Interchangeability. Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

R201.3 Terms defined in other codes. Terms that are not defined in this Code but are defined in the *EPCOT Building Code*; *EPCOT Fire Prevention Code*; *EPCOT Fuel Gas Code*; *EPCOT Mechanical Code*; or *EPCOT Plumbing Code* shall have the meanings ascribed to them in those codes.

R201.4 Terms not defined. Terms not defined by this Chapter shall have ordinarily accepted meanings such as the context implies.

SECTION R202 GENERAL DEFINITIONS

ABOVE-GRADE WALL. A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

ACCESSIBLE. Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see “Readily accessible”).

ADDITION. An extension or increase in the conditioned space floor area or height of a building or structure.

ADJACENT WALL, CEILING or FLOOR. A wall, ceiling or floor of a structure that separates conditioned space from enclosed but unconditioned space, such as an unconditioned attached garage, storage or utility room.

AIR BARRIER. Relating to air distribution systems, a material object(s) that impedes or restricts the free movement of air under specified conditions. For fibrous glass duct, the air barrier is its foil cladding; for flexible nonmetal duct, the air barrier is the nonporous core; and for sheet metal duct and air handling units, the air barrier is the metal in contact with the air stream. For mechanical closets, the air barrier may be a uniform panelized material such as gypsum wallboard that meets ASTM C36, or it may be a membrane that alone acts as an air barrier which is attached to a panel, such as the foil cladding of fibrous glass duct board.

Relating to the building envelope, air barriers comprise the planes of primary resistance to airflow between the interior spaces of a building and the outdoors and the planes of primary airflow resistance between adjacent air zones of a building, including planes between adjacent conditioned and uncondi-

tioned air spaces of a building. To be classed as an air barrier, a building plane must be substantially leak free; that is, it shall have an air leakage rate not greater than 0.5 cfm/ft² when subjected to an air pressure gradient of 25 pascal. In general, air barriers are made of durable, nonporous materials and are sealed to adjoining wall, ceiling or floor surfaces with a suitable long-life mastic. House wraps and taped and sealed dry-wall may constitute an air barrier, but dropped acoustical tile ceilings (T-bar ceilings) may not. Batt insulation facings and asphalt-impregnated fiberboard and felt paper are not considered air barriers.

AIR CONDITIONING. The treatment of air so as to control simultaneously the temperature, humidity, cleanness and distribution of the air to meet the requirements of a conditioned space.

AIR DISTRIBUTION SYSTEM. Any system of ducts, plenums and air-handling equipment that circulates air within a space or spaces and includes systems made up of one or more air-handling units.

AIR-HANDLING UNIT. The fan unit of a furnace and the fan-coil unit of a split-system, packaged air conditioner or heat pump.

ALTERATION. Any construction, retrofit or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

APPROVED. Approval by the Building Official as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the Building Official.

ATTIC. An enclosed unconditioned space located immediately below an uninsulated roof and immediately above the ceiling of a building. For the roof to be considered insulated, roof insulation shall be at least the *R*-value required to meet Subsection R405.2.1.

AUTOMATIC. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see “Manual”).

BASEMENT WALL. A wall 50 percent or more below grade and enclosing conditioned space.

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy. For each purpose of this Code, each portion of a building separated from other portions by a firewall shall be considered as a separate building.

DEFINITIONS

The term “building” shall be construed as if followed by the words “or part thereof.”

BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this Code, or a duly authorized representative.

BUILDING SITE. A contiguous area of land that is under the ownership or control of one entity.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space. See “Adjacent wall, ceiling or floor.”

C-FACTOR (THERMAL CONDUCTANCE). The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces ($\text{Btu/h} \cdot \text{ft}^2 \cdot ^\circ\text{F}$) [$\text{W}/(\text{m}^2 \cdot \text{K})$].

CIRCULATING HOT WATER SYSTEM. A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

CLIMATE ZONE. A geographical region based on climatic criteria as specified in this Code.

COMMERCIAL BUILDING. For this Code, all buildings that are not included in the definition of “Residential building.”

CONDITIONED FLOOR AREA. The horizontal projection of that portion of space that is conditioned directly or indirectly by an energy-using system.

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces; where they are separated from conditioned spaces by uninsulated walls, floors or ceilings; or where they contain uninsulated ducts, piping or other sources of heating or cooling. See “Space.”

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

CRAWL SPACE WALL. The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

DEMAND RECIRCULATION WATER SYSTEM. A water distribution system where pump(s) prime the service hot water piping with heated water upon demand for hot water.

DRAWBAND. A fastener that surrounds and fastens a duct fitting with either the inner lining or the outer jacket of flexible ducts. Tension ties, clinch bands, draw ties, and straps are considered drawbands.

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

EFFICIENCY. Performance at specified rating conditions.

ENERGY. The capacity for doing work. It takes a number of forms that may be transformed from one into another such as thermal (heat), mechanical (work), electrical and chemical. Customary measurement units are British thermal units (Btu).

ENERGY ANALYSIS. A method for estimating the annual energy use of the proposed design and standard reference design based on estimates of energy use.

ENERGY COST. The total estimated annual cost for purchased energy for the building functions regulated by this Code, including applicable demand charges.

ENERGY SIMULATION TOOL. An approved software program or calculation-based methodology that projects the annual energy use of a building.

EQUIPMENT. Devices for comfort conditioning, electric power, lighting, transportation or service water heating including, but not limited to, furnaces, boilers, air conditioners, heat pumps, chillers, water heaters, lamps, luminaires, ballasts, elevators, escalators or other devices or installations.

ERI REFERENCE DESIGN. A version of the rated design that meets the minimum requirements of the 2006 *International Energy Conservation Code*.

EXISTING BUILDING. A building or portion thereof that was previously occupied or approved for occupancy by the authority having jurisdiction.

EXTERIOR WALL. Walls including both above-grade walls and basement walls that form a boundary between a conditioned and an outdoor space.

FENESTRATION. Products classified as either vertical fenestration or skylights.

FENESTRATION AREA. Total area of the fenestration measured using the rough opening and including the glazing, sash and frame. For doors where the glazed vision area is less than 50 percent of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area.

FENESTRATION PRODUCT, SITE-BUILT. A fenestration designed to be made up of field-glazed or field-assembled units using specific factory cut or otherwise factory-formed framing and glazing units. Examples of site-built

fenestration include storefront systems, curtain walls and atrium roof systems.

F-FACTOR. The perimeter heat loss factor for slab-on-grade floors (Btu/h · ft · °F) [$W/(m \cdot K)$].

HEAT. The form of energy that is transferred by virtue of a temperature difference or a change in the state of a material.

HEATED SLAB. Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

HIGH-EFFICACY LAMPS. Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts;
2. 50 lumens per watt for lamps over 15 watts to 40 watts; and
3. 40 lumens per watt for lamps 15 watts or less.

HISTORIC BUILDING. Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
2. Designated as historic under an applicable state or local law.
3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.

HVAC. Heating, ventilating and air conditioning.

HVAC SYSTEM. The equipment, distribution systems and terminals that provide, either collectively or individually, the processes of heating, ventilating, or air conditioning to a building or portion of a building.

INDOOR. Within the conditioned building envelope.

INFILTRATION. The uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building caused by pressure differences across these elements due to factors such as wind, inside and outside temperature differences (stack effect), and imbalance between supply and exhaust air systems.

INSULATED SIDING. A type of continuous insulation with manufacturer-installed insulating material as an integral part of the cladding product having a minimum *R*-value of *R*-2.

INSULATING SHEATHING. An insulating board with a core material having a minimum *R*-value of *R*-2.

INSULATION. Material mainly used to retard the flow of heat. See Subsection R303.1.1.

LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and where labeling indicates either that

the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the Building Official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and where the listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

LOW-VOLTAGE LIGHTING. Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

MANUAL. Capable of being operated by personal intervention (see “Automatic”).

MANUFACTURER. The company engaged in the original production and assembly of products or equipment or a company that purchases such products and equipment manufactured in accordance with company specifications.

MECHANICAL CLOSET. For the purposes of this Code, a closet used as an air plenum that contains the blower unit or air handler of a central air-conditioning or heating unit.

OUTDOOR. The environment exterior to the building structure.

OUTDOOR (OUTSIDE) AIR. Air that is outside the building envelope or is taken from outside the building that has not been previously circulated through the building.

OUTSIDE. The environment exterior to the conditioned space of the building and may include attics, garages, crawl-spaces, etc., but not return air plenums.

PLENUM. A compartment or chamber to which one or more ducts are connected, that forms a part of the air distribution system, and that is not used for occupancy or storage. A plenum often is formed in part or in total by portions of the building.

POSITIVE INDOOR PRESSURE. A positive pressure condition within a conditioned space caused by bringing in more outside air than the amount of air that is exhausted and/or lost through air leakage.

PROPOSED DESIGN. A description or computer representation of the proposed building used to estimate annual energy use for determining compliance based on total building performance or design energy cost.

RATED DESIGN. A description of the proposed building used to determine the energy rating index.

READILY ACCESSIBLE. Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see “Accessible”).

RENOVATED BUILDING. A residential or nonresidential building undergoing alteration that varies or changes insulation, HVAC systems, water heating systems or exterior envelope conditions, provided the estimated cost of renovation exceeds 30 percent of the assessed value of the structure.

DEFINITIONS

REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

REPLACEMENT. The installation of part or all of an existing mechanical or electrical system in an existing building.

REROOFING. The process of recovering or replacing an existing roof covering. See “Roof recover” and “Roof replacement.”

RESIDENTIAL BUILDING. For this Code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.

ROOF ASSEMBLY. A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof covering, underlayment, roof deck, insulation, vapor retarder and interior finish.

ROOF RECOVER. The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

ROOF REPAIR. Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

ROOF REPLACEMENT. The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$) [$\text{m}^2 \cdot \text{K}/\text{W}$].

SEAL or SEALING – AIR DUCT. The use of closure products, either welds, mastic, mastic plus embedded fabric, adhesives, caulking, gaskets, pressure-sensitive tapes, heat-activated tapes or combinations thereof as allowed by specific sections of this Code, to close cracks, joints, seams and other openings in the air barriers of air ducts, air handling units and plenum chambers for the purpose of preventing air leakage. No joining of opening from which a closure product is absent shall be considered sealed unless considered otherwise in specific cases identified by this Code. Closeness of fit between mated parts alone shall not be considered a seal.

SERVICE WATER HEATING. Supply of hot water for purposes other than comfort heating.

SKYLIGHT. Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal. Glazing materials in skylights, including unit skylights, tubular daylighting devices, solariums, sunrooms, roofs and sloped walls, are included in this definition.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar

radiation that is then reradiated, conducted or convected into the space. (See “Fenestration area.”)

SPACE. An enclosed space within a building. The classifications of spaces are as follows for the purpose of determining building envelope requirements.

1. Conditioned space: a cooled space, heated space or indirectly conditioned space or unvented attic assembly defined as follows:
 - a. Cooled space: an enclosed space within a building that is cooled by a cooling system whose sensible output capacity exceeds $5 \text{ Btu/h} \cdot \text{ft}^2$ of floor area.
 - b. Heated space: an enclosed space within a building that is heated by a heating system whose output capacity relative to the floor area is greater than or equal to $5 \text{ Btu/h} \cdot \text{ft}^2$.
 - c. Indirectly conditioned space: an enclosed space within a building that is not a heated space or a cooled space, which is heated or cooled indirectly by being connected to adjacent space(s) provided (a) the product of the U -factor(s) and surface area(s) of the space adjacent to connected space(s) exceeds the combined sum of the product of the U -factor(s) and surface area(s) of the space adjoining the outdoors, unconditioned spaces, and to or from semiheated spaces (e.g., corridors) or (b) that air from heated or cooled spaces is intentionally transferred (naturally or mechanically) into the space at a rate exceeding 3 air changes per hour (ACH) (e.g., atria).
 - d. Unvented attic assembly: as defined in Subsection 705.6 of the *EPCOT Building Code*. These spaces shall not require supply or return outlets.
2. Semiheated space: an enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to $3.4 \text{ Btu/h} \cdot \text{ft}^2$ of floor area but is not a conditioned space.
3. Unconditioned space: an enclosed space within a building that is not a conditioned space or a semiheated space. Crawl spaces, attics, and parking garages with natural or mechanical ventilation are not considered enclosed spaces.

STANDARD REFERENCE DESIGN. A version of the proposed design that meets the minimum requirements of this Code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

STRUCTURE. That which is built or constructed.

SUNROOM. For the purposes of this Code, the term “sunroom” as used herein shall be as follows and shall include conservatories, sunspaces, solariums, and porch or patio covers or enclosures.

1. A room with roof panels that includes sloped glazing that is a one-story structure added to an existing dwelling with an open or glazed area in excess of 40 percent of the gross area of the sunroom structure’s exterior walls and roof.

2. A one-story structure added to a dwelling with structural roof panels without sloped glazing. The sunroom walls may have any configuration, provided the open area of the longer wall and one additional wall is equal to at least 65 percent of the area below 6 feet 8 inches of each wall, measured from the floor.

SYSTEM. A combination of equipment and auxiliary devices (e.g., controls, accessories, interconnecting means and terminal elements) by which energy is transformed so it performs a specific function such as HVAC, service water heating or lighting.

THERMAL ENVELOPE. The primary insulation layer of a building; that part of the envelope that provides the greatest resistance to heat flow to or from the building.

THERMAL ISOLATION. Physical and space conditioning separation from conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

THERMOSTAT. An automatic control device used to maintain temperature at a fixed or adjustable set point.

U-FACTOR (THERMAL TRANSMITTANCE). The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films ($\text{Btu/h} \cdot \text{ft}^2 \cdot ^\circ\text{F}$) [$\text{W}/(\text{m}^2 \cdot \text{K})$].

UNCONDITIONED SPACE. See “Space.”

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

VENTILATION AIR. That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

VERTICAL FENESTRATION. Windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of at least 60 degrees (1.05 rad) from horizontal.

VISIBLE TRANSMITTANCE [VT]. The ratio of visible light entering the space through the fenestration product assembly to the incident visible light, Visible Transmittance, includes the effects of glazing material and frame and is expressed as a number between 0 and 1.

WALL. That portion of the building envelope, including opaque area and fenestration, that is vertical or tilted at an angle of 60 degrees from horizontal or greater. This includes above- and below-grade walls, between floor spandrels, peripheral edges of floors and foundation walls. For the purposes of determining building envelope requirements, the classifications are defined as follows:

1. Above-grade wall: a wall that is not a below-grade wall.

2. Below-grade wall: that portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.
3. Mass wall: a wall with a heat capacity exceeding (1) 7 $\text{Btu/ft}^2 \cdot ^\circ\text{F}$ or (2) 5 $\text{Btu/ft}^2 \cdot ^\circ\text{F}$, provided that the wall has a material unit weight not greater than 120 lb/ft^3 .
4. Metal building wall: a wall whose structure consists of metal spanning members supported by steel structural members (i.e., does not include spandrel glass or metal panels in curtain wall systems).
5. Steel-framed wall: a wall with a cavity (insulated or otherwise) whose exterior surfaces are separated by steel framing members (i.e., typical steel stud walls and curtain wall systems).
6. Wood-framed and other walls: all other wall types, including wood stud walls.

WHOLE HOUSE MECHANICAL VENTILATION SYSTEM. An exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates.

ZONE. A space or group of spaces within a building with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.

CHAPTER 3 [RE]

GENERAL REQUIREMENTS

SECTION R301 CLIMATE ZONES

R301.1 General. Table R301.1 shall be used in determining the applicable requirements from Chapter 4. Locations are assigned a climate zone based on Subsection R301.3.

Figure R301.1 Climate Zones. Reserved.

R301.2 Warm humid counties. Warm humid counties are identified in Table R301.1 by an asterisk.

R301.3 International climate zones. The climate zone for any location outside the United States shall be determined by applying Table R301.3(1) and then Table R301.3(2).

R301.4 Tropical climate zone. The tropical climate zone shall be defined as:

1. Hawaii, Puerto Rico, Guam, American Samoa, U.S. Virgin Islands, Commonwealth of Northern Mariana Islands; and
2. Islands in the area between the Tropic of Cancer and the Tropic of Capricorn.

SECTION R302 DESIGN CONDITIONS

R302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

SECTION R303 MATERIALS, SYSTEMS AND EQUIPMENT

R303.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this Code.

R303.1.1 Building thermal envelope insulation.

R303.1.1.1 Insulation product rating. The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (CFR Title 16, Part 460) in units of $\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$ at a mean temperature of 75°F (24°C).

R303.1.1.1.1 *R*-values referenced in Chapter 4 of this Code refer to the *R*-values of the added insulation only. The *R*-values of structural building materials such as framing members, concrete blocks or gypsum board shall not be included.

Exception: R402.1.5 Total UA Alternative.

R303.1.1.1.2 When installing two layers of bulk or board insulation, the *R*-values of each material may be added together for a total *R*-value. When installing two separate reflective insulation products in layers, the total *R*-value of the system shall have been achieved by testing under FTC regulations, 16 CFR Part 460.

TABLE R301.1
CLIMATE ZONES, MOISTURE REGIMES AND
WARM-HUMID DESIGNATIONS BY COUNTY

Key: A – Moist

Asterisk (*) indicates a warm-humid location.

FLORIDA	2A Duval*	2A Indian River*	2A Nassau*	2A Sumter*
2A Alachua*	2A Escambia*	2A Jackson*	2A Okaloosa*	2A Suwannee*
2A Baker*	2A Flagler*	2A Jefferson*	2A Okeechobee*	2A Taylor*
2A Bay*	2A Franklin*	2A Lafayette*	2A Orange*	2A Union*
2A Bradford*	2A Gadsden*	2A Lake*	2A Osceola*	2A Volusia*
2A Brevard*	2A Gilchrist*	1A Lee*	1A Palm Beach*	2A Wakulla*
1A Broward*	2A Glades*	2A Leon*	2A Pasco*	2A Walton*
2A Calhoun*	2A Gulf*	2A Levy*	2A Pinellas*	2A Washington*
2A Charlotte*	2A Hamilton*	2A Liberty*	2A Polk*	
2A Citrus*	2A Hardee*	2A Madison*	2A Putnam*	
2A Clay*	1A Hendry*	2A Manatee*	2A Santa Rosa*	
1A Collier*	2A Hernando*	2A Marion*	2A Sarasota*	
2A Columbia*	2A Highlands*	2A Martin*	2A Seminole*	
2A DeSoto*	2A Hillsborough*	1A Miami-Dade*	2A St. Johns*	
2A Dixie*	2A Holmes*	1A Monroe*	2A St. Lucie*	

GENERAL REQUIREMENTS

TABLE R301.3(1)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

MAJOR CLIMATE TYPE DEFINITIONS	
Marine (C) Definition—Locations meeting all four criteria:	
<ol style="list-style-type: none"> 1. Mean temperature of coldest month between -3°C (27°F) and 18°C (65°F). 2. Warmest month mean < 22°C (72°F). 3. At least four months with mean temperatures over 10°C (50°F). 4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere. 	
Dry (B) Definition—Locations meeting the following criteria:	
Not marine and $P_{in} < 0.44 \times (TF - 19.5)$ [$P_{cm} < 2.0 \times (TC + 7)$ in SI units] where: P_{in} = Annual precipitation in inches (cm) T = Annual mean temperature in °F (°C)	
Moist (A) Definition—Locations that are not marine and not dry.	
Warm-humid Definition—Moist (A) locations where either of the following wet-bulb temperature conditions shall occur during the warmest six consecutive months of the year:	
<ol style="list-style-type: none"> 1. 67°F (19.4°C) or higher for 3,000 or more hours; or 2. 73°F (22.8°C) or higher for 1,500 or more hours. 	

For SI: °C = [(°F) - 32]/1.8, 1 inch = 2.54 cm.

TABLE R301.3(2)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
1	9000 < CDD50°F	5000 < CDD10°C
2	6300 < CDD50°F ≤ 9000	3500 < CDD10°C ≤ 5000
3A and 3B	4500 < CDD50°F ≤ 6300 AND HDD65°F ≤ 5400	2500 < CDD10°C ≤ 3500 AND HDD18°C ≤ 3000
4A and 4B	CDD50°F ≤ 4500 AND HDD65°F ≤ 5400	CDD10°C ≤ 2500 AND HDD18°C ≤ 3000
3C	HDD65°F ≤ 3600	HDD18°C ≤ 2000
4C	3600 < HDD65°F ≤ 5400	2000 < HDD18°C ≤ 3000
5	5400 < HDD65°F ≤ 7200	3000 < HDD18°C ≤ 4000
6	7200 < HDD65°F ≤ 9000	4000 < HDD18°C ≤ 5000
7	9000 < HDD65°F ≤ 12600	5000 < HDD18°C ≤ 7000
8	12600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F) - 32]/1.8.

R303.1.1.1.3 Insulated siding. The thermal resistance (*R*-value) of insulated siding shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer's instructions.

R303.1.1.2 Building thermal envelope insulation markers. An *R*-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element

of the building thermal envelope. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be listed on the certification. For insulated siding, the *R*-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

R303.1.1.2.1 Blown or sprayed roof/ceiling insulation. The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m²) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be listed on certification provided by the insulation installer.

R303.1.1.2.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.

R303.1.2 Equipment efficiency ratings. Minimum equipment efficiency rating identification for heating, cooling, hot water, swimming pool heating and filtration, and lighting shall be in accordance with industry standards and as described in Chapter 4 of the Commercial Provisions of this Code, as applicable, for such equipment.

R303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

Exception: Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from Table R303.1.3(1) or R303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

**TABLE R303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTORS**

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

**TABLE R303.1.3(2)
DEFAULT DOOR *U*-FACTORS**

DOOR TYPE	<i>U</i> -FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

**TABLE R303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT**

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

R303.2 Installation. Materials, systems and equipment shall be installed in accordance with the manufacturer's instructions and the *EPCOT Building Code*.

R303.2.1 Insulation installation. Insulation materials shall comply with the requirements of their respective ASTM standard specification and shall be installed in accordance with their respective ASTM installation practice in Table R303.2.1 in such a manner as to achieve rated *R*-value of insulation. Open-blown or poured loose-fill insulation shall not be used in attic roof spaces when the slope of the ceiling is more than 3 in 12. When eave vents are installed, baffling of the vent openings shall be provided to deflect the incoming air above the surface of the insulation.

Exception: Where metal building roof and metal building wall insulation is compressed between the roof or wall skin and the structure.

R303.2.1.1 Compressed insulation. Insulation that has been compressed to 85 percent or less of the manufacturer's rated thickness for the product shall use the *R*-values given in Table 303.2.1.1. These values are to be used except where data developed by an independent testing laboratory are provided.

R303.2.1.2 Substantial contact. Insulation shall be installed in a permanent manner in substantial contact with the inside surface in accordance with manufacturer's recommendations for the framing system used. Flexible batt insulation installed in floor cavities shall be supported in a permanent manner by supports no greater than 24 inches (610 mm) on center (o.c.).

Exception: Insulation materials that rely on air-spaces adjacent to reflective surfaces for their rated performance.

R303.2.1.3 Insulation protection. Exterior insulation shall be covered with a protective material to prevent

GENERAL REQUIREMENTS

**TABLE R303.2.1
INSULATION INSTALLATION STANDARDS**

INSULATION MATERIAL	STANDARD SPECIFICATION	INSTALLATION PRACTICE
Mineral Fiber Batt/Blanket	ASTM C665	ASTM C1320
Mineral Fiber Loose Fill	ASTM C764	ASTM C1015
Cellulose Loose Fill	ASTM C739	ASTM C1015
Polystyrene Foam	ASTM C578	—
Polyisocyanurate Foam	ASTM C1289	—
Reflective	ASTM C1224	ASTM C727
Radiant Barrier	ASTM C1313	ASTM C1158
Vermiculite	ASTM C516	—
Perlite	ASTM C549	—
Spray-applied Rigid Cellular Polyurethane Foam	ASTM C1029	—
Interior Radiation Control Coating Systems	—	ASTM C1321

**TABLE R303.2.1.1
R-VALUES OF COMPRESSED INSULATION**

% OF ORIGINAL THICKNESS	R-5	R-7	R-11	R-14	R-19	R-30	R-38
90	5	6	10	13	18	28	36
80	4	6	10	12	17	26	33
70	4	5	9	11	15	24	30
60	3	5	8	10	14	22	27
50	3	4	7	9	12	18	24
40	2	4	6	8	10	15	20
30	2	3	4	6	8	12	16
20	2	2	2	3	4	10	10

damage from sunlight, moisture, landscaping operations, equipment maintenance and wind. In attics and mechanical rooms, a way to access equipment that prevents damaging or compressing the insulation shall be provided. Foundation vents shall not interfere with the insulation. Insulation materials in ground contact shall have a water absorption rate no greater than .3 percent when tested in accordance with ASTM C272, shall cover the exposed exterior insulation and shall extend a minimum of 6 inches (153 mm) below grade.

R303.3 Maintenance information. Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

CHAPTER 4 [RE]

RESIDENTIAL ENERGY EFFICIENCY

SECTION R401 GENERAL

R401.1 Scope. This Chapter applies to residential buildings.

R401.2 Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 labeled “Mandatory.”
3. An energy rating index (ERI) approach in Section R406.

R401.2.1 Tropical zone. Residential buildings in the tropical zone at elevations below 2,400 feet (731.5 m) above sea level shall be deemed to comply with this Chapter where the following conditions are met:

1. Not more than one-half of the occupied space is air conditioned.
2. The occupied space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in conditioned space has a solar heat gain coefficient of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior roof surface complies with one of the options in Table C402.3 or the roof/ceiling has insulation with an *R*-value of *R*-15 or greater. If present, attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a minimum slope of $\frac{1}{4}$ inch per foot of run. The finished roof does not have water accumulation areas.
8. Operable fenestration provides ventilation area equal to not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

R401.3 Energy performance level (EPL) display card (Mandatory). The Building Official shall require that an energy performance level (EPL) display card be completed

and certified by the builder to be accurate and correct before final approval of the building for occupancy. Florida law (Section 553.9085, *Florida Statutes*) requires the EPL display card to be included as an addendum to each sales contract for both presold and nonpresold residential buildings. The EPL display card contains information indicating the energy performance level and efficiencies of components installed in a dwelling unit. The Building Official shall verify that the EPL display card completed and signed by the builder accurately reflects the plans and specifications submitted to demonstrate code compliance for the building. A copy of the EPL display card can be found in Appendix RD.

SECTION R402 BUILDING THERMAL ENVELOPE

R402.1 General (Prescriptive). The building thermal envelope shall meet the requirements of Subsections R402.1.1 through R402.1.5.

Exception: The following low-energy buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this Section shall be exempt from the building thermal envelope provisions of Section R402.

1. Those with a peak design rate of energy usage less than $3.4 \text{ Btu/h} \cdot \text{ft}^2$ (10.7 W/m^2) or 1.0 watt/ft^2 of floor area for space-conditioning purposes.
2. Those that do not contain conditioned space.

R402.1.1 Vapor retarder. Wall assemblies in the building thermal envelope shall comply with the vapor retarder requirements of the *EPCOT Building Code*.

R402.1.2 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Table R402.1.2, based on the climate zone specified in Chapter 3.

R402.1.3 *R*-value computation. Insulation material used in layers, such as framing cavity insulation, or continuous insulation shall be summed to compute the corresponding component *R*-value. The manufacturer’s settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer’s labeled *R*-value for insulated siding shall be reduced by *R*-0.6.

R402.1.4 *U*-factor alternative. An assembly with a *U*-factor equal to or less than that specified in Table R402.1.4 shall be permitted as an alternative to the *R*-value in Table R402.1.2.

R402.1.5 Total UA alternative. If the total building thermal envelope UA (sum of *U*-factor times assembly area) is

RESIDENTIAL ENERGY EFFICIENCY

less than or equal to the total UA resulting from using the *U*-factors in Table R402.1.4 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table R402.1.2. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

R402.2 Specific insulation requirements (Prescriptive). In addition to the requirements of Subsection R402.1, insulation shall meet the specific requirements of Subsections R402.2.1 through R402.2.13.

R402.2.1 Ceilings with attic spaces. Where Subsection R402.1.2 would require R-38 insulation in the ceiling, installing R-30 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at

TABLE R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^{b, j}	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^c WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^h	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

- R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
- The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.
- "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- The first value is cavity insulation, the second value is continuous insulation, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation.
- The second *R*-value applies when more than half the insulation is on the interior of the mass wall.
- For impact rated fenestration complying with the *EPCOT Building Code*, the maximum *U*-factor shall be 0.65 in Climate Zone 2.

TABLE R402.1.4
EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

- Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
- Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Table R301.1.

the eaves. Similarly, where Subsection R402.1.2 would require R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the *U*-factor alternative approach in Subsection R402.1.4 and the total UA alternative in Subsection R402.1.5.

R402.2.2 Ceilings without attic spaces. Where Subsection R402.1.2 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Subsection R402.1.2 shall be limited to 500 square feet (46 m²) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the *U*-factor alternative approach in Subsection R402.1.4 and the total UA alternative in Subsection R402.1.5.

R402.2.3 Eave baffle. For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.

R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood-framed or equivalent baffle or retainer is required to be provided when loose-fill insulation is installed, the purpose of which is to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed *R*-value of the loose-fill insulation.

Exception: Vertical doors that provide access from conditioned to unconditioned spaces shall be permitted to meet the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.

R402.2.5 Mass walls. Mass walls for the purposes of this Chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs, or any other walls having a heat capacity greater than or equal to 6 Btu/ft² · °F (123 kJ/m² · K).

R402.2.6 Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls, and floors shall meet the insulation requirements of Table R402.2.6 or shall meet the *U*-factor requirements of Table R402.1.4. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

R402.2.7 Walls with partial structural sheathing. Where Subsection R402.1.2 would require continuous insulation on exterior walls and structural sheathing covers 40 percent or less of the gross area of all exterior walls, the continuous insulation *R*-value shall be permitted to be reduced by an amount necessary to result in a consistent total sheathing thickness, but not more than R-3, on areas of the walls covered by structural sheathing. This reduction shall not apply to the *U*-factor alternative approach in Subsection R402.1.4 and the total UA alternative in Subsection R402.1.5.

TABLE R402.2.6
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION
(*R*-VALUE)

WOOD FRAME <i>R</i> -VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT <i>R</i> -VALUE ^a
Steel Truss Ceilings^b	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings^b	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-Framed Wall, 16" on center	
R-13	R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1
R-13 + 3	R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel Framed Wall, 24" on center	
R-13	R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4
R-13 + 3	R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20 + 5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

a Cavity insulation *R*-value is listed first, followed by continuous insulation *R*-value.

b. Insulation exceeding the height of the framing shall cover the framing.

R402.2.8 Floors. Floor framing-cavity insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

Exception: The floor framing-cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall *R*-value in Table 402.1.2 and that extends from the bottom to the top of all perimeter floor framing members.

R402.2.9 Basement walls. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Subsections R402.1.2 and R402.2.8.

R402.2.10 Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Slab-edge insulation is not required in jurisdictions designated by the Building Official as having a very heavy termite infestation.

R402.2.11 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *EPCOT Building Code*. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

R402.2.12 Masonry veneer. Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

R402.2.13 Sunroom insulation. Sunrooms enclosing conditioned space shall meet the insulation requirements of this Code.

Exception: For sunrooms with thermal isolation, and enclosing conditioned space, the following exceptions to the insulation requirements of this Code shall apply:

1. The minimum ceiling insulation *R*-values shall be R-19 in Climate Zones 1 through 4 and R-24 in Climate Zones 5 through 8.
2. The minimum wall *R*-value shall be R-13 in all Climate Zones. Walls separating a sunroom with a thermal isolation from conditioned space shall meet the building thermal envelope requirements of this Code.

R402.2.14 Common walls/ceilings/floors. Walls, ceilings or floors common to separate conditioned tenancies shall be insulated to a minimum R-11, space permitting.

Exception: Mass common walls shall be insulated to a minimum of R-6.

R402.3 Fenestration (Prescriptive). In addition to the requirements of Section R402, fenestration shall comply with Subsections R402.3.1 through R402.3.5.

R402.3.1 U-factor. An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

R402.3.2 Glazed fenestration SHGC. An area-weighted average of fenestration products more than 50-percent glazed shall be permitted to satisfy the SHGC requirements.

Dynamic glazing shall be permitted to satisfy the SHGC requirements of Table R402.1.2 provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

Exception: Dynamic glazing is not required to comply with this Section when both the lower and higher labeled SHGC already comply with the requirements of Table R402.1.2.

R402.3.3 Glazed fenestration exemption. Up to 15 square feet (1.4 m²) of glazed fenestration per dwelling unit shall be permitted to be exempt from *U*-factor and SHGC requirements in Subsection R402.1.2. This exemption shall not apply to the *U*-factor alternative approach in Subsection R402.1.4 and the Total UA alternative in Subsection R402.1.5.

R402.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the *U*-factor requirement in Subsection R402.1.4. This exemption shall not apply to the *U*-factor alternative approach in Subsection R402.1.4 and the total UA alternative in Subsection R402.1.5.

R402.3.5 Sunroom fenestration. Sunrooms enclosing conditioned space shall meet the fenestration requirements of this Code.

Exception: For sunrooms with thermal isolation and enclosing conditioned space in Climate Zones 2 through 8, the maximum fenestration *U*-factor shall be 0.45 and the maximum skylight *U*-factor shall be 0.70.

New fenestration separating the sunroom with thermal isolation from conditioned space shall meet the building thermal envelope requirements of this Code.

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Subsections R402.4.1 through R402.4.5.

Exception: Dwelling units of R-2 Occupancies and multiple attached single family dwellings shall be permitted to comply with Subsection C402.5.

R402.4.1 Building thermal envelope. The building thermal envelope shall comply with Subsections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation. The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the Building Official, an approved third party shall inspect all components and verify compliance.

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding seven air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380 and reported at a pressure of 0.2 inch w.g. (50 pascals). Testing shall be conducted by either individuals as defined in Section 553.993(5) or (7), *Florida Statutes*, or individuals licensed as set forth in Section 489.105(3)(f), (g) or (i) or an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the Building Official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

Exception: Testing is not required for additions, alterations, renovations or repairs of the building thermal envelope of existing buildings in which the new construction is less than 85 percent of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but

not sealed beyond intended infiltration control measures.

3. Interior doors, if installed at the time of the test, shall be open.
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems, if installed at the time of the test, shall be turned off.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

R402.4.3 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

R402.4.4 Rooms containing fuel-burning appliances. In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall *R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Fireplaces and stoves complying with the *EPCOT Building Code*.

R402.4.5 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

**TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION**

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

SECTION R403 SYSTEMS

R403.1 Controls.

R403.1.1 Thermostat provision (Mandatory). At least one thermostat shall be provided for each separate heating and cooling system.

R403.1.2 Programmable thermostat (Prescriptive). The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed by the manufacturer with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

R403.1.3 Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

R403.2 Hot water boiler outdoor temperature setback. Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

R403.3 Ducts. Ducts and air handlers shall be in accordance with Subsections R403.3.1 through R403.3.5.

R403.3.1 Insulation (Prescriptive). Supply and return ducts in attics shall be insulated to a minimum of R-8 where 3 inches (76 mm) in diameter and greater and R-6 where less than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches (76 mm) in diameter or greater and R-4.2 where less than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

R403.3.2 Sealing (Mandatory). All ducts, air handlers, filter boxes and building cavities that form the primary air containment passageways for air distribution systems shall be considered ducts or plenum chambers, shall be constructed and sealed in accordance with Subsection C403.2.9.2 of the Commercial Provisions of this Code and shall be shown to meet duct tightness criteria below.

Duct tightness shall be verified by testing in accordance with ANSI/RESNET/ICC 380 by either individuals as defined in Section 553.993(5) or (7), *Florida Statutes*, or individuals licensed as set forth in Section 489.105(3)(f), (g) or (i), *Florida Statutes*, to be “substantially leak free” in accordance with Subsection R403.3.3.

R403.3.2.1 Sealed air handler. Air handlers shall have a manufacturer’s designation for an air leakage of no

more than 2 percent of the design airflow rate when tested in accordance with ASHRAE 193.

R403.3.3 Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.
2. Duct testing is not mandatory for buildings complying by Section 405 of this Code.

A written report of the results of the test shall be signed by the party conducting the test and provided to the Building Official.

R403.3.4 Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Subsection R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.
2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

R403.3.5 Building cavities (Mandatory). Building framing cavities shall not be used as ducts or plenums.

R403.3.6 Air-handling units. Air-handling units shall not be installed in the attic when a home is brought into code compliance by Section R402. Air-handling units shall be allowed in attics for compliance by Section R405 only if the following conditions are met:

1. The service panel of the equipment is located within 6 feet (1829 mm) of an attic access.
2. A device is installed to alert the owner or shut down the unit when the condensation drain is not working properly.
3. The attic access opening is of sufficient size to replace the air handler.

4. A notice is posted on the electric service panel indicating to the homeowner that the air handler is located in the attic. Said notice shall be in all capitals, in 16-point type, with the title and first paragraph in bold:

NOTICE TO HOMEOWNER

A PART OF YOUR AIR-CONDITIONING SYSTEM, THE AIR HANDLER, IS LOCATED IN THE ATTIC. FOR PROPER, EFFICIENT AND ECONOMIC OPERATION OF THE AIR-CONDITIONING SYSTEM, YOU MUST ENSURE THAT REGULAR MAINTENANCE IS PERFORMED. YOUR AIR-CONDITIONING SYSTEM IS EQUIPPED WITH ONE OR BOTH OF THE FOLLOWING: (1) A DEVICE THAT WILL ALERT YOU WHEN THE CONDENSATION DRAIN IS NOT WORKING PROPERLY OR (2) A DEVICE THAT WILL SHUT DOWN THE SYSTEM WHEN THE CONDENSATION DRAIN IS NOT WORKING. TO LIMIT POTENTIAL DAMAGE TO YOUR HOME, AND TO AVOID DISRUPTION OF SERVICE, IT IS RECOMMENDED THAT YOU ENSURE PROPER WORKING ORDER OF THESE DEVICES BEFORE EACH SEASON OF PEAK OPERATION.

R403.4 Mechanical system piping insulation (Mandatory). Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-3.

R403.4.1 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

R403.5 Service hot water systems. Energy conservation measures for service hot water systems shall be in accordance with Subsections R403.5.1 through R403.5.6.

R403.5.1 Heated water circulation and temperature maintenance systems (Mandatory). Heated water circulation systems shall be in accordance with Subsection R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Subsection R403.5.1.2. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

R403.5.1.1 Circulation systems. Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermosiphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for

hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

R403.5.1.2 Heat trace systems. Electric heat trace systems shall comply with IEEE 515.1 or UL 515. Controls for such systems shall automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy.

R403.5.2 Demand recirculation systems. A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a demand recirculation water system. Pumps shall have controls that comply with both of the following:

1. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.
2. The control shall limit the temperature of the water entering the cold water piping to 104°F (40°C).

R403.5.3 Hot water pipe insulation (Prescriptive). Insulation for hot water pipe with a minimum thermal resistance (R-value) of R-3 shall be applied to the following:

1. Piping $\frac{3}{4}$ inch (19.1 mm) and larger in nominal diameter.
2. Piping serving more than one dwelling unit.
3. Piping located outside the conditioned space.
4. Piping from the water heater to a distribution manifold.
5. Piping located under a floor slab.
6. Buried in piping.
7. Supply and return piping in recirculation systems other than demand recirculation systems.

R403.5.4 Drain water heat recovery units. Drain water heat recovery units shall comply with CSA B55.2. Drain water heat recovery units shall be tested in accordance with CSA B55.1. Potable water-side pressure loss of drain water heat recovery units shall be less than 3 psi (20.7 kPa) for individual units connected to one or two showers. Potable water-side pressure loss of drain water heat recovery units shall be less than 2 psi (13.8 kPa) for individual units connected to three or more showers.

R403.5.5 Heat traps (Mandatory). Storage water heaters not equipped with integral heat traps and having vertical pipe risers shall have heat traps installed on both the inlets and outlets. External heat traps shall consist of either a commercially available heat trap or a downward and upward bend of at least $3\frac{1}{2}$ inches (89 mm) in the hot water distribution line and cold water line located as close as possible to the storage tank.

R403.5.6 Water heater efficiencies (Mandatory).**R403.5.6.1 Storage water heater temperature controls.**

403.5.6.1.1 Automatic controls. Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use. The minimum temperature setting range shall be from 100°F to 140°F (38°C to 60°C).

R403.5.6.1.2 Shut down. A separate switch or a clearly marked circuit breaker shall be provided to permit the power supplied to electric service systems to be turned off. A separate valve shall be provided to permit the energy supplied to the main burner(s) of combustion types of service water-heating systems to be turned off.

R403.5.6.2 Water-heating equipment. Water-heating equipment installed in residential units shall meet the minimum efficiencies of Table C404.2 in Chapter 4 of the Commercial Provisions of this Code, for the type of equipment installed. Equipment used to provide heating functions as part of a combination system shall satisfy all stated requirements for the appropriate water-heating category. Solar water heaters shall meet the criteria of Subsection R403.5.6.2.1.

R403.5.6.2.1 Solar water-heating systems. Solar systems for domestic hot water production are rated by the annual solar energy factor of the system. The solar energy factor of a system shall be determined from the Florida Solar Energy Center Directory of Certified Solar Systems. Solar collectors shall be tested in accordance with ISO Standard 9806, *Test Methods for Solar Collectors*, and SRCC Standard TM-1, *Solar Domestic Hot Water System and Component Test Protocol*. Collectors in installed solar water-heating systems should meet the following criteria:

1. Be installed with a tilt angle between 10 degrees and 40 degrees of the horizontal; and
2. Be installed at an orientation within 45 degrees of true south.

R403.6 Mechanical ventilation (Mandatory). The building shall be provided with ventilation that meets the requirements of the *EPCOT Mechanical Code* or with other approved means of ventilation including: Natural, Infiltration or

Mechanical means. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

R403.6.1 Whole-house mechanical ventilation system fan efficacy. When installed to function as a whole-house mechanical ventilation system, fans shall meet the efficacy requirements of Table R403.6.1.

Exception: Where whole-house mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

R403.6.2 Ventilation air. Residential buildings designed to be operated at a positive indoor pressure or for mechanical ventilation shall meet the following criteria:

1. The design air change per hour minimums for residential buildings in ASHRAE 62.2, *Ventilation for Acceptable Indoor Air Quality*, shall be the maximum rates allowed for residential applications.
2. No ventilation or air-conditioning system make-up air shall be provided to conditioned space from attics, crawlspaces, attached enclosed garages or outdoor spaces adjacent to swimming pools or spas.
3. If ventilation air is drawn from enclosed space(s), then the walls of the space(s) from which air is drawn shall be insulated to a minimum of R-11 and the ceiling shall be insulated to a minimum of R-19, space permitting, or R-10 otherwise.

R403.7 Heating and cooling equipment (Mandatory).

R403.7.1 Equipment sizing. Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on the equipment loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies, based on building loads for the directional orientation of the building. The manufacturer and model number of the outdoor and indoor units (if split system) shall be submitted along with the sensible and total cooling capacities at the design conditions described in Subsection R302.1. This Code does not allow designer safety factors, provisions for future expansion or other factors that affect equipment sizing. System sizing calculations shall not include loads created by local intermittent mechanical ventilation such as standard kitchen and bathroom exhaust systems. New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed.

TABLE R403.6.1
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY* (CFM/WATT)	AIRFLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916

R403.7.1.1 Cooling equipment capacity. Cooling only equipment shall be selected so that its total capacity is not less than the calculated total load but not more than 1.15 times greater than the total load calculated according to the procedure selected in Subsection 403.7, or the closest available size provided by the manufacturer's product lines. The corresponding latent capacity of the equipment shall not be less than the calculated latent load.

The published value for AHRI total capacity is a nominal, rating-test value and shall not be used for equipment sizing. Manufacturer's expanded performance data shall be used to select cooling-only equipment. This selection shall be based on the outdoor design dry-bulb temperature for the load calculation (or entering water temperature for water-source equipment), the blower CFM provided by the expanded performance data, the design value for entering wet-bulb temperature and the design value for entering dry-bulb temperature.

Design values for entering wet-bulb and dry-bulb temperatures shall be for the indoor dry bulb and relative humidity used for the load calculation and shall be adjusted for return side gains if the return duct(s) is installed in an unconditioned space.

Exceptions:

1. Attached single- and multiple-family residential equipment sizing may be selected so that its cooling capacity is less than the calculated total sensible load but not less than 80 percent of that load.
2. When signed and sealed by a Florida-registered engineer, in attached single- and multiple-family units, the capacity of equipment may be sized in accordance with good design practice.

R403.7.1.2 Heating equipment capacity.

R403.7.1.2.1 Heat pumps. Heat pump sizing shall be based on the cooling requirements as calculated according to Subsection R403.7.1.1, and the heat pump total cooling capacity shall not be more than 1.15 times greater than the design cooling load even if the design heating load is 1.15 times greater than the design cooling load.

R403.7.1.2.2 Electric resistance furnaces. Electric resistance furnaces shall be sized within 4 kW of the design requirements calculated according to the procedure selected in Subsection R403.7.1.

R403.7.1.2.3 Fossil fuel heating equipment. The capacity of fossil fuel heating equipment with natural draft atmospheric burners shall not be less than the design load calculated in accordance with Subsection R403.7.1.

R403.7.1.3 Extra capacity required for special occasions. Residences requiring excess cooling or heating equipment capacity on an intermittent basis,

such as anticipated additional loads caused by major entertainment events, shall have equipment sized or controlled to prevent continuous space cooling or heating within that space by one or more of the following options:

1. A separate cooling or heating system is utilized to provide cooling or heating to the major entertainment areas.
2. A variable capacity system sized for optimum performance during base load periods is utilized.

R403.8 Systems serving multiple dwelling units (Mandatory). Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the Commercial Provisions of this Code in lieu of Section R403.

R403.9 Snow melt and ice system controls (Mandatory). Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C), and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (4.8°C).

R403.10 Pools and permanent spa energy consumption (Mandatory). The energy consumption of pools and permanent spas shall be in accordance with Subsections R403.10.1 through R403.10.5.

R403.10.1 Heaters. The electric power to heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with continuously burning ignition pilots.

R403.10.2 Time switches. Time switches or other control methods that can automatically turn off and on according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this Section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.
3. Where pumps are powered exclusively from on-site renewable generation.

R403.10.3 Covers. Outdoor heated swimming pools and outdoor permanent spas shall be equipped with a vapor-retardant cover on or at the water surface or a liquid cover or other means proven to reduce heat loss.

Exception: Where more than 70 percent of the energy for heating, computed over an operation season, is from site-recovered energy, such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

R403.10.4 Gas- and oil-fired pool and spa heaters. All gas- and oil-fired pool and spa heaters shall have a minimum thermal efficiency of 82 percent for heaters manufactured on or after April 16, 2013, when tested in accordance with ANSI Z 21.56. Pool heaters fired by natural or LP gas shall not have continuously burning pilot lights.

R403.10.5 Heat pump pool heaters. Heat pump pool heaters shall have a minimum COP of 4.0 when tested in accordance with AHRI 1160, Table 2, Standard Rating Conditions-Low Air Temperature. A test report from an independent laboratory is required to verify procedure compliance. Geothermal swimming pool heat pumps are not required to meet this standard.

R403.11 Portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP-14.

R403.12 Residential pools and permanent residential spas. Residential swimming pools and permanent residential spas that are accessory to detached one- and two-family dwellings and townhouses three stories or less in height above grade plane and that are available only to the household and its guests shall be in accordance with APSP-15.

SECTION R404 ELECTRICAL POWER AND LIGHTING SYSTEMS

R404.1 Lighting equipment (Mandatory). Not less than 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 75 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

Exception: Low-voltage lighting.

R404.1.1 Lighting equipment (Mandatory). Fuel gas lighting systems shall not have continuously burning pilot lights.

SECTION R405 SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)

R405.1 Scope. This Section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling and service water heating energy only.

R405.2 Mandatory requirements. Compliance with this Section requires that the mandatory provisions identified in Subsection R401.2 be met. All supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R405.2.1 Ceiling insulation. Ceilings shall have an insulation level of at least R-19, space permitting. For the purposes of this Code, types of ceiling construction that are considered to have inadequate space to install R-19 include single assembly ceilings of the exposed deck and beam type and concrete deck roofs. Such ceiling assemblies shall be insulated to at least a level of R-10.

R405.3 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have annual total normalized Modified Loads that are less than or equal to the annual total loads of the standard reference design as calculated in accordance with Appendix RC of this standard.

R405.4 Documentation. Documentation of the software used for the performance design and the parameters for the building shall be in accordance with Subsections R405.4.1 through R405.4.3.

R405.4.1 Compliance software tools. Computer software utilized for demonstration of code compliance shall have been approved by the Florida Building Commission in accordance with requirements of this Code.

R405.4.2 Compliance report. Compliance software tools shall generate a report that documents that the proposed design complies with Subsection R405.3. A compliance report on the proposed design shall be submitted with the application for the building permit. Upon completion of the building, a compliance report based on the as-built condition of the building shall be submitted to the Building Official before a Certificate of Occupancy is issued. Batch sampling of buildings to determine energy code compliance for all buildings in the batch shall be prohibited.

Compliance reports shall include information in accordance with Subsections R405.4.2.1 and R405.4.2.2. Where the proposed design of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the proposed design for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case building air leakage and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

R405.4.2.1 Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the proposed design complies with Subsection R405.3.
3. An inspection checklist documenting the building component characteristics of the proposed design as indicated in Table R405.5.2(1). The inspection checklist shall show results for the proposed design with user inputs to the compliance software to generate the results.
4. A site-specific energy analysis report that is in compliance with Subsection R405.3.
5. The name of the individual performing the analysis and generating the report.
6. The name and version of the compliance software tool.

Exception: Multiple orientations. When an otherwise identical building model is offered in multiple

orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four cardinal (north, east, south and west) orientations, or the “Worst” orientation. Compliance software tools may calculate the “Worst Case” orientation by rotating the building through the 4 or 8 cardinal orientations.

R405.4.2.2 Compliance report for Certificate of Occupancy. A compliance report submitted for obtaining the Certificate of Occupancy shall include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the as-built building complies with Subsection R405.3.
3. A certificate indicating that the building passes the performance matrix for code compliance and listing the energy saving features of the buildings.
4. A site-specific energy analysis report that is in compliance with Subsection R405.3.
5. The name of the individual performing the analysis and generating the report.
6. The name and version of the compliance software tool.

R405.4.3 Additional documentation. The Building Official shall be permitted to require the following documents:

1. Verification that an EPL display card signed by the builder providing the building component characteristics of the proposed design will be provided to the purchaser of the home at time of title transfer.
2. Documentation of the component efficiencies used in the software calculations for the proposed design.

R405.5 Calculation procedure. Calculations of the performance design shall be in accordance with Subsections R405.5.1 through R405.5.3.

R405.5.1 General. Except as specified by this Section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

R405.5.2 Residence specifications. The standard reference design and proposed design shall be configured and analyzed as specified by Table R405.5.2(1). Table R405.5.2(1) shall include, by reference, all notes contained in Table R402.1.2.

R405.5.3 Calculation requirements for glazing.

R405.5.3.1 Glass areas. All glazing areas of a residence, including windows, sliding glass doors, glass in doors, skylights, etc., shall include the manufacturer’s frame area in the total window area. Window measurements shall be as specified on the plans and specifications for the residence.

Exception: When a window in existing exterior walls is enclosed by an addition, an amount equal to the area of this window may be subtracted from the glazing area for the addition for that overhang and orientation.

R405.5.3.2 Overhangs. Overhang effect is measured by Overhang Separation, which is the vertical measure of the distance from the top of a window to the bottom of the overhang. The overhang for adjustable exterior shading devices shall be determined at its most extended position. Nonpermanent shading devices such as canvas awnings shall not be considered overhangs. Permanently attached wood and metal awnings may be considered overhangs.

R405.5.3.3 Doors with glazing. For doors that are opaque or where the glass is less than one-third of the area of the door, the total door area shall be included in the door calculation. For unlabeled sliding glass doors or when glass areas in doors are greater than or equal to one-third of the area of the door, the glazing portion shall be included in the glazing calculation and the opaque portion of the door shall be included in the door calculation. When glass areas in doors are greater than or equal to one-third of the area of the door, the door shall be included in the glazing calculation as a total fenestration using the tested *U*-factor and solar heat gain coefficient.

R405.5.3.4 Maximum fenestration SHGC. The Proposed Design must have either an area-weighted average maximum fenestration SHGC of 0.50 or a window area-weighted average overhang depth of 4.0 feet or greater (all conditioned space windows must be included in the calculation). The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Subsection R402.1.5 or Section R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 1 through 3 shall be 0.50.

TABLE R405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame	As proposed
	Gross area: same as proposed	As proposed
	<i>U</i> -factor: as specified in Table R402.1.4	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawl space walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	<i>U</i> -factor: from Table R402.1.4, with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	<i>U</i> -factor: as specified in Table R402.1.4	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	<i>U</i> -factor: as specified in Table R402.1.4	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft ² per 300 ft ² ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
	Foundation wall area above and below grade and soil characteristics: same as proposed	As proposed
Opaque doors	Area: 40 ft ²	As proposed
	Orientation: North	As proposed
	<i>U</i> -factor: same as fenestration from Table R402.1.4	As proposed
Vertical fenestration other than opaque doors	Vertical fenestration area ^b = (a) The proposed vertical fenestration area, where the proposed fenestration area is less than 15 percent of the conditioned floor area, or (b) The adjusted vertical fenestration area, where the proposed fenestration area is 15 percent or more of the conditioned floor area. The adjusted vertical fenestration area shall be calculated as follows: $AVF_{adj} = AVF \cdot 0.15 \cdot CFA / AF$ where: AVF_{adj} = adjusted vertical fenestration AVF = proposed vertical fenestration area CFA = conditioned floor area AF = proposed total fenestration area	As proposed
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W)	As proposed
	<i>U</i> -factor: as specified in Table R402.1.4	As proposed
	SHGC: as specified in Table R402.1.2 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design)	0.92 - (0.21 × SHGC as proposed)
	External shading: none	As proposed

(continued)

TABLE R405.5.2(1)—continued
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Skylights	Skylight area = (a) The proposed skylight area, where the proposed fenestration area is less than 15 percent of the conditioned floor area, or (b) The adjusted skylight area, where the proposed fenestration area is 15 percent or greater of the conditioned floor area. The adjusted skylight area shall be calculated as follows: $ASKY_{adj} = ASKY \cdot 0.15 \cdot CFA / AF$ where: $ASKY_{adj}$ = adjusted skylight area $ASKY$ = proposed skylight area CFA = conditioned floor area AF = proposed total fenestration area	As proposed
	Orientation: as proposed	As proposed
	U-factor: as specified in Table R402.1.4	As proposed
	SHGC: as specified in Table R402.1.2 including footnote (b) of that table, except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	Interior shade fraction for the area of proposed skylights with SHGC ratings that include a pre-installed interior shade: $0.92 - (0.21 \cdot SHGC \text{ for the standard reference design})$	As proposed, with shades assumed closed 50% of the time
	External shading: none	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Air leakage rate of 7.00 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 at a pressure of 0.2 inches w.g. (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	The measured air exchange rate ^a . The mechanical ventilation rate ^b shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: $kWh/yr = 0.03942 \times CFA + 29.565 \times (N_{br} + 1)$ where: CFA = conditioned floor area N_{br} = number of bedrooms	As proposed
Internal gains	$IGain = 17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)	Same as standard reference design.
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element ^c but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.4 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems ^{d, e}	Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with Subsection R403.7 Fuel type: same as proposed	As proposed As proposed As proposed

(continued)

TABLE R405.5.2(1)—continued
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Cooling systems ^{d, f}	Fuel type: electric Capacity: sized in accordance with Subsection R403.7. Efficiency: in accordance with prevailing federal minimum standards	As proposed As proposed As proposed
Service water heating ^{d, e, f, g}	Fuel type: as proposed Use: same as proposed design Efficiency: in accordance with prevailing federal minimum standards	As proposed gal/day = $30 + (10 \times N_{br})$ As proposed
Thermal distribution systems	Distribution system efficiency: 0.88 Duct location: entirely within the building thermal envelope Air handler location: entirely within the building thermal envelope Duct insulation: R-6	Thermal distribution system efficiency shall be as tested in accordance with ANSI/RES-NET/ICC 380 or if not tested, shall be modeled as a Qn to outside of 0.080 for ducted systems. Hydronic and ductless systems shall be as specified in Table R405.5.2(2) if not tested. As proposed As proposed As proposed
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

- Where required by the Building Official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, or the equivalent shall be used to determine the energy loads resulting from infiltration.
- The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the “Whole-house Ventilation” provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
- Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
- For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
- For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
- For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
- For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.
- For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine fenestration area:

$$AF = A_s \cdot FA \cdot F$$

where:

AF = Total fenestration area.

A_s = Standard reference design total fenestration area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.80, whichever is greater,

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

L and CFA are in the same units.

TABLE R405.5.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS^a

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS ^b
Distribution system components located in unconditioned space	—	0.95
Untested distribution systems entirely located in conditioned space ^c	—	1
“Ductless” systems ^d	1	—

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093 m², 1 pound per square inch = 6895 Pa, 1 inch water gauge = 1250 Pa.

- Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
- Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.
- Entire system in conditioned space shall mean that no component of the distribution system, including the air-handler unit, is located outside of the conditioned space.
- Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer’s air-handler enclosure.

R405.6 Calculation software tools. Calculation software, where used, shall be in accordance with Subsections R405.6.1 through R405.6.3.

R405.6.1 Minimum capabilities. Calculation procedures used to comply with this Section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:

- Computer generation of the standard reference design using only the input for the proposed design. The calculation procedure shall not allow the user to directly modify the building component characteristics of the standard reference design.
- Calculation of whole-building (as a single zone) sizing for the heating and cooling equipment in the standard reference design residence in accordance with Subsection R403.6.
- Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
- Printed Building Official inspection checklist listing each of the proposed design component characteristics from Table R405.5.2(1) determined by the analysis to provide compliance, along with their respective performance ratings (*R*-value, *U*-factor, SHGC, HSPF, AFUE, SEER, EF are some examples).

R405.6.2 Specific approval. Performance analysis tools meeting the applicable provisions of Section R405 shall be permitted to be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The Building Official shall be permitted to approve tools for a specified application or limited scope.

R405.6.3 Input values. When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an approved source.

R405.6.3.1 Water-heating EF adjustment factors. The Energy Factor (EF) of an instantaneous water heater [those with capacity of two gallons (7.57 L) or less] in the Proposed home shall be reduced to 92 percent of the value in the manufacturer’s documentation or AHRI *Directory of Certified Product Performance*.

R405.7 Requirements specific to credit options. Credit may be claimed in the software compliance calculation for technologies that meet prescriptive criteria specified as follows for various options.

R405.7.1 Installation criteria for homes claiming the radiant barrier option. The sheet radiant barrier or IRCC options may be claimed where the radiant barrier system is to be installed in one of the configurations depicted in Figure R405.7.1 and the following conditions are met:

- It shall be fabricated over a ceiling insulated to a minimum of R-19 with conventional insulation and shall not be used as a means to achieve partial or whole compliance with a minimum attic insulation level of R-19. Either a sheet type or spray applied interior radiation control coating (IRCC) may be used.
- If the radiant barrier material has only one surface with high reflectivity or low emissivity, it shall be facing downward toward the ceiling insulation.
- The attic airspace shall be vented in accordance with the *EPCOT Building Code*.
- The radiant barrier system shall conform to ASTM C1313, *Standard Specification for Sheet Radiant Barriers for Building Construction Applications*, or ASTM C1321, *Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction* as appropriate for the type of radiant barrier to be installed. The operative surface shall have an emissivity not greater than 0.06 for sheet radiant barriers or 0.25 for interior radiation control coatings as demonstrated by independent laboratory testing according to ASTM C1371.
- The radiant barrier system (RBS) shall conform with ASTM C1158, *Use and Installation of Radiant Bar-*

rier Systems (RBS) in Building Constructions for Sheet Radiant Barriers, or ASTM C1321, *Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction* for IRCC systems.

6. The radiant barrier shall be installed so as to cover gable ends without closing off any soffit, gable or roof ventilation.

R405.7.2 Installation criteria for homes claiming the cool roof option. The cool roof option may be claimed where the roof to be installed has a tested solar reflectance of greater than 4 percent when evaluated in accordance with ASTM methods E-903, C-1549, E-1918 or CRRC Method #1. Emittance values provided by the roofing manufacturer in accordance with ASTM C1371 shall be used when available. In cases where the appropriate data are not known, emittance shall be the same as the Standard Reference Design. Testing of a qualifying sample of the

roofing material shall be performed by an approved independent laboratory with these results provided by the manufacturer.

R405.7.3 Installation criteria for homes using the unvented attic assembly option. The unvented attic assembly option may be used if the criteria in the *EPCOT Building Code* have been met.

R405.7.4 Installation criteria for homes using the cross ventilation option. The cross ventilation option may be used if the following criteria have been met:

1. Operable aperture areas totaling a minimum of 12 percent of the floor area of the room shall be provided for all primary living areas and main bedrooms.
2. Insect screens shall be provided for all operable windows, skylights and doors to be considered operable aperture area. All screened entry doors and interior doors in the ventilated areas shall be provided with

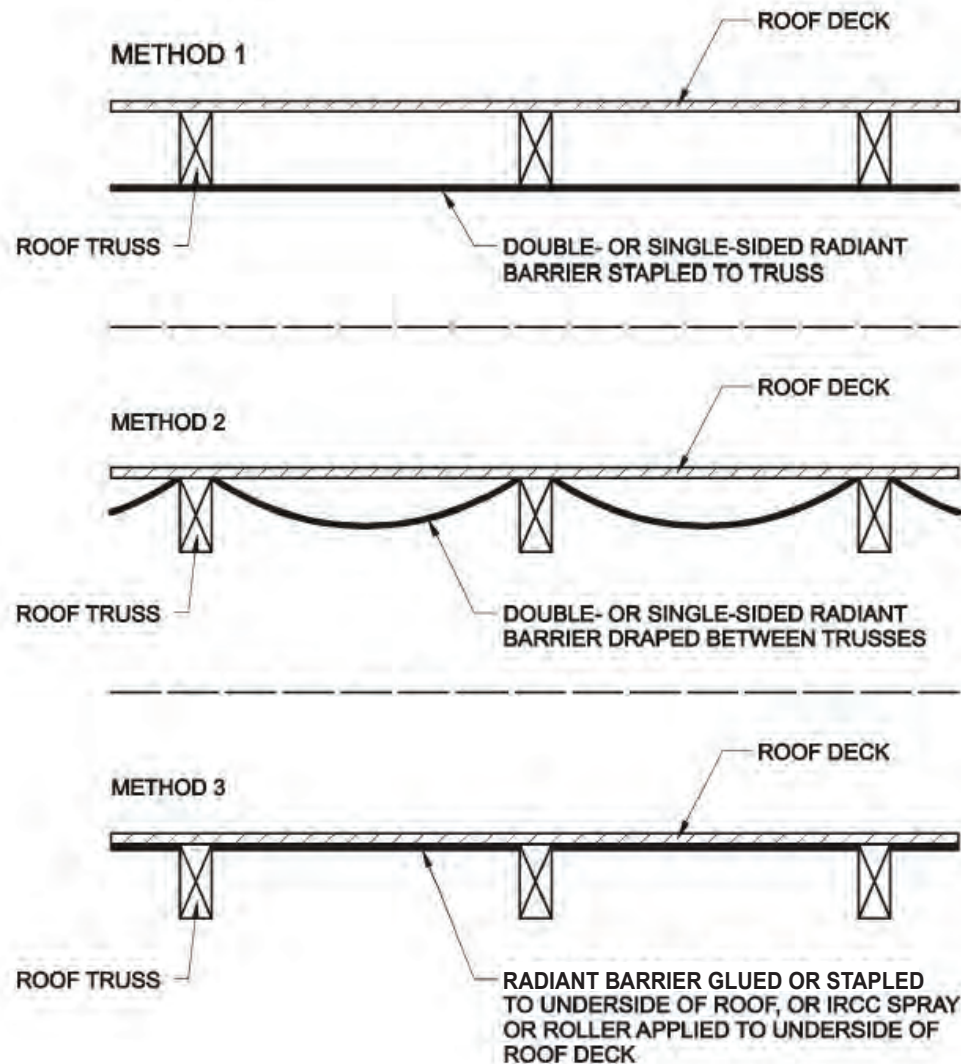


FIGURE R405.7.1
ACCEPTABLE ATTIC RADIANT BARRIER CONFIGURATIONS

either (1) mechanically attached door stops (or similar devices) to hold the door in an open position or (2) operable louvers.

3. The total aperture area shall be provided by a minimum of two distinct windows or one window and one skylight. Each operable unit shall provide not more than 70 percent of the total aperture area. The windows (or sliding glass doors) shall be placed in walls adjacent or opposite to each other. The windows may be placed on a single outside wall if a skylight or wing walls are used.
4. Where wing walls are included in the building design for ventilation purposes, they shall be placed between windows to create a high-pressure and a low-pressure zone on each window. Wing walls shall extend from the ground to eave height, be located on the windward side of the building and extend outward from the building a distance at least equal to one-half the width of the window. NOTE: This technique is effective only for areas that experience significant and continuous winds during the cooling months.

R405.7.5 Installation criteria for homes using the whole house fan option. The whole house fan option may be used if the following criteria have been met:

1. The whole house fan has been sized to provide a minimum of 20 air changes per hour for the entire house.
2. The fan installed shall have a free air cfm rating of at least three times the square footage of the conditioned area of the house.
3. To ensure adequate air exhaust, the house attic shall have gable, ridge or wind turbine vents whose total opening area is equal to four times the ceiling cutout area for the whole house fan. Soffit vents shall not be included in the exhaust vent area.

R405.7.6 Installation criteria for homes using the ceiling fan option. The ceiling fan option shall apply a 2 percent reduction in cooling energy use for the proposed design if one or more ceiling fans are installed in each of the bedrooms and a minimum of one ceiling fan is installed in all primary living areas (living rooms, family rooms or great rooms). This shall not include spaces designed to be dining rooms or dining areas. Areas separated by permanently fixed archways, walls or dividers shall be considered separate rooms. The following criteria shall be met:

1. Ceiling fans shall be installed with minimum fan blade diameters of no less than those listed in Table R405.7.6 for the size and shape of the room.
2. Where a primary living area is an “L-shaped” room and the smaller portion of this area is 8 feet by 10 feet (2438 mm by 3048 mm) or larger, a fan shall be installed in both the larger and smaller portions of the primary living area.
3. Ceiling fans shall be ENERGY STAR certified.

Exception: Credit shall not be taken for both ceiling fans and cross ventilation.

**TABLE R405.7.6
FAN SIZING TABLE**

LONGEST WALL LENGTH (feet)	MINIMUM FAN SIZE (inches)
= 12	36
> 12–16	48
> 16–17.5	52
> 17.5–25	56
> 25	2 fans (minimum of 48 inches each)

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

R405.7.7 Installation criteria for homes claiming the heat recovery unit (HRU) option. The heat recovery unit option may be used for installation of a waste heat recovery unit (HRU) on either an air conditioner or a heat pump where the heat recovery unit has a minimum net useful heat exchange effect of 50 percent and meets the following criteria:

1. The net useful heat exchange effect shall be demonstrated by either a Form 400D-2017 prominently displayed on the unit with test results clearly visible for inspection or by an ARDM-certified refrigerant desuperheater seal affixed to the unit.
2. The net useful heat exchange effect shall have been determined by an independent laboratory testing to AHRI Standard 470.
3. If more than one air-conditioning system is installed in a residence and only one HRU is installed, energy load shall be based on the gallon capacity of the water heater to which it is coupled and the total capacity of the water heaters in the residence. In such case, the HRU shall be attached to the system serving the daytime primary living areas (family room, living room, kitchen, dining room and adjacent bedrooms and bathrooms).

R405.7.8 Installation criteria for homes claiming the dedicated heat pump option. The dedicated heat pump option may be used for a dedicated heat pump (also known as a heat pump water heater) installed either with a tank (an integral unit) or without tank (add-on to another water heater) based on the COP or energy factor (EF) of the system on which it is installed. No minimum rating is required for this equipment.

SECTION R406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

R406.1 Scope. This Section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

R406.2 Mandatory requirements. Compliance with this Section requires that the provisions identified in Sections R401 through R404 labeled as “mandatory” and Subsection R403.5.3 of the 2015 *International Energy Conservation Code* be met. For buildings that do not utilize on-site renewable power production for compliance with this Section, the building thermal envelope shall be greater than or equal to

levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the 2009 *International Energy Conservation Code*. For buildings that utilize on-site renewable power production for compliance with this Section, the building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table R402.1.2 or Table R402.1.4 of the 2015 *International Energy Conservation Code*.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.3 Energy Rating Index. The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the ERI reference design has an Index value of 100 and a residential building that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the annual total normalized modified loads of the rated design relative to the annual total loads of the ERI reference design. The ERI shall consider all energy used in the residential building.

R406.3.1 ERI reference design. The ERI reference design shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements.

R406.4 ERI-based compliance. The ERI for the rated design shall be determined in accordance with ANSI/RESNET/ICC 301, including Addendum A-2015, and be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4.

**TABLE R406.4
MAXIMUM ENERGY RATING INDEX**

CLIMATE ZONE	ENERGY RATING INDEX
1	58
2	58
3	51
4	54
5	55
6	54
7	53
8	53

R406.5 Verification by approved agency. Verification of compliance with Section R406 shall be completed by an approved third party, in accordance with *Florida Statutes* 553.990 (Building Energy Efficiency Rating System).

R406.6 Documentation. Documentation of the software used to determine the ERI and the parameters for the residential building shall be in accordance with Subsections R406.6.1 through R406.6.3.

R406.6.1 Compliance software tools. Computer software utilized for demonstration of code compliance shall have been approved by the Florida Building Commission in accordance with requirements of this Code.

R406.6.2 Compliance report. Compliance software tools shall generate a report that documents that the ERI of the

rated design complies with Subsections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the rated design. The inspection checklist shall show results for both the ERI reference design and the rated design, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.6.3 Additional documentation. The Building Official shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the ERI reference design.
2. A certification signed by the builder providing the building component characteristics of the rated design.
3. Documentation of the actual values used in the software calculations for the rated design.

R406.7 Calculation software tools. Calculation software, where used, shall be in accordance with Subsections R406.7.1 through R406.7.3.

R406.7.1 Minimum capabilities. Calculation procedures used to comply with this Section shall be software tools capable of calculating the ERI as described in Subsection R406.3, and shall include the following capabilities:

1. Computer generation of the ERI reference design using only the input for the rated design.
The calculation procedure shall not allow the user to directly modify the building component characteristics of the ERI reference design.
2. Calculation of whole building, as a single zone, sizing for the heating and cooling equipment in the ERI reference design residence in accordance with Subsection R403.7.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed Building Official inspection checklist listing each of the rated design component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

R406.7.2 Specific approval. Performance analysis tools meeting the applicable sections of Section R406 shall be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The Building Official shall approve tools for a specified application or limited scope.

R406.7.3 Input values. When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an approved source.

CHAPTER 5 [RE]

EXISTING BUILDINGS

SECTION R501 GENERAL

R501.1 Scope. The provisions of this Chapter shall control the alteration, repair, addition and Change of Occupancy of existing buildings and structures.

R501.1.1 Additions, alterations, or repairs: General. Additions, alterations, or repairs to an existing building, building system or portion thereof shall comply with Section R502, R503 or R504. Unaltered portions of the existing building or building supply system shall not be required to comply with this Code.

R501.2 Existing buildings. Except as specified in this Chapter, this Code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this Code.

R501.3 Maintenance. Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this Code shall be maintained in conformance to the code edition under which installed. The owner or the owner's authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this Chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

R501.4 Compliance. Alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in the *EPCOT Building Code*; *EPCOT Fire Prevention Code*; *EPCOT Fuel Gas Code*; *EPCOT Mechanical Code*; *EPCOT Plumbing Code*, and NFPA 70.

R501.5 New and replacement materials. Except as otherwise required or permitted by this Code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.

R501.6 Historic buildings. No provision of this Code relating to the construction, repair, alteration, restoration and movement of structures, and Change of Occupancy shall be mandatory for historic buildings provided a report has been submitted to the Building Official and signed by the owner, a registered design professional, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic form, fabric or function of the building.

R501.7 Building systems and components. Thermal efficiency standards are set for the following building systems

and components where new products are installed or replaced in existing buildings, and for which a permit must be obtained. New products shall meet the minimum efficiencies allowed by this Code for the following systems and components:

Heating, ventilating or air-conditioning systems;
Service water or pool heating systems;
Lighting systems; and
Replacement fenestration.

Exceptions:

1. Where part of a functional unit is repaired or replaced. For example, replacement of an entire HVAC system is not required because a new compressor or other part does not meet code when installed with an older system.
2. If the unit being replaced is itself a functional unit, such as a condenser, it does not constitute a repair. Outdoor and indoor units that are not designed to be operated together must meet the U.S. Department of Energy certification requirements contained in Subsection R303.1.2. Matched systems are required; this match may be verified by any one of the following means:
 - a. AHRI data
 - b. Accredited laboratory
 - c. Manufacturer's letter
 - d. Letter from registered P.E. State of Florida
3. Where existing components are utilized with a replacement system, such as air distribution system ducts or electrical wiring for lights, such components or controls need not meet code if meeting code would require that component's replacement.
4. Replacement equipment that would require extensive revisions to other systems, equipment or elements of a building where such replacement is a like-for-like replacement, such as through-the-wall condensing units and PTACs, chillers and cooling towers in confined spaces.

R501.7.1 Existing equipment efficiencies. Existing cooling and heating equipment in residential applications need not meet the minimum equipment efficiencies, including system sizing and duct sealing.

SECTION R502 ADDITIONS

R502.1 General. Additions to an existing building, building system or portion thereof shall conform to the provisions of this Code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this Code. Additions shall not

create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this Code where the addition alone complies, where the existing building and addition comply with this Code as a single building, or where the building with the addition uses no more energy than the existing building. Additions shall be in accordance with Subsection R502.1.1, R502.1.2 or R502.1.3.

R502.1.1 Prescriptive compliance. Additions shall comply with Subsections R502.1.1.1 through R502.1.1.4.

R502.1.1.1 Building envelope. New building envelope assemblies that are part of the addition shall comply with Subsections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: Where nonconditioned space is changed to conditioned space, the building envelope of the addition shall comply where the UA, as determined in Subsection 402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to UA generated for the existing building.

R502.1.1.2 Heating and cooling systems. New heating, cooling and duct systems that are part of the addition shall comply with Subsections R403.1, R403.2, R403.3, R403.5 and R403.6.

Exception: Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Subsection R403.3.3.

R502.1.1.3 Service hot water systems. New service hot water systems that are part of the addition shall comply with Subsection R403.4.

R502.1.1.4 Lighting. New lighting systems that are part of the addition shall comply with Subsection R404.1.

R502.1.2 Simulated performance alternative. The addition or existing building and addition together shall comply with Section R405 in its entirety.

R502.1.3 Energy Rating Index compliance alternative. The addition or existing building and addition together shall comply with Section R406 in its entirety.

SECTION R503 ALTERATIONS

R503.1 General. Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less conforming to the provisions of this Code than the existing building or structure was prior to the alteration.

Alterations to an existing building, building system or portion thereof shall conform to the provisions of this Code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this Code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems.

Alterations shall be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Subsections R503.1.1 through R503.2.

R503.1.1 Building envelope. Building envelope assemblies that are part of the alteration shall comply with Subsection R402.1.2 or R402.1.4, Subsections R402.2.1 through R402.2.13, R402.3.1, R402.3.2, R402.4.3 and R402.4.5.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof recover.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing or fenestration assembly to be replaced.
7. Swimming pool filtration pumps and motors.

R503.1.1.1 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC as provided in Table R402.1.2.

R503.1.2 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Subsections R403.1, R403.2, R403.3 and R403.6.

Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Subsection R403.3.3.

R503.1.3 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Subsection R403.4.

R503.1.4 Lighting. New lighting systems that are part of the alteration shall comply with Subsection 404.1.

Exception: Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

R503.2 Change in space conditioning. Any nonconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this Code.

Exception: Where the simulated performance option in Section R405 is used to comply with this Section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Subsection R405.3.

SECTION R504 REPAIRS

R504.1 General. Buildings, structures and parts thereof shall be repaired in compliance with Subsection R501.3 and this Section. Work on nondamaged components necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this Chapter. Routine maintenance required by Subsection R501.3, ordinary repairs exempt from permit, and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this Section.

R504.2 Application. For the purposes of this Code, the following shall be considered repairs:

1. Glass-only replacements in an existing sash and frame.
2. Roof repairs.
3. Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided that the replacement does not increase the installed interior lighting power.

SECTION R505 CHANGE OF OCCUPANCY OR USE

R505.1 General. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this Code.

R505.2 General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this Code.

Exception: Where the simulated performance option in Section R405 is used to comply with this Section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Subsection R405.3.

CHAPTER 6 [RE]

REFERENCED STANDARDS

This Chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 106.

AAMA

American Architectural Manufacturers Association
1827 Walden Office Square
Suite 550
Schaumburg, IL 60173-4268

Standard reference number	Title	Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A C440—11	North American Fenestration Standard/ Specifications for Windows, Doors and Unit Skylights	R402.4.3

ACCA

Air Conditioning Contractors of America
2800 Shirlington Road, Suite 300
Arlington, VA 22206

Standard reference number	Title	Referenced in code section number
Manual D—09	Residential Duct Systems.	C403.2.9.5
Manual J—2011	Residential Load Calculation Eighth Edition.	R403.7.1
Manual S—13	Residential Equipment Selection	R403.7.1

AHRI

Air Conditioning, Heating, & Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington, VA 22201

Standard reference number	Title	Referenced in code section number
470—06	Performance Rating of Desuperheater/Water Heaters	R405.7.7, Appendix RD Form R400D
1160—08	Performance Rating of Heat Pump Pool Heaters Directory of Certified Product Performance	R403.10.1.2, R405.6.3.1

ANSI

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036

Standard reference number	Title	Referenced in code section number
ANSI/RESNET/ ICC 301—2014	Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings Using an Energy Rating Index.	R406.4
ANSI/RESNET/ ICC 301—2014, Addendum A-2015	Amendment on Domestic Hot Water Systems.	R406.4
ANSI/RESNET/ ICC 380—2016	Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems and Airflow of Mechanical Ventilation Systems	R402.4.1.2, R403.3.2, Table R405.5.2(1) and Appendix RD
Z21.56-2006	Gas-Fired Pool Heaters	R403.10.4

REFERENCED STANDARDS

APSP

The Association of Pool & Spa Professionals
2111 Eisenhower Avenue, Suite 500
Alexandria, VA 22314

Standard reference number	Title	Referenced in code section number
ANSI/APSP/ICC 14—14	American National Standard for Portable Electric Spa Energy Efficiency	R403.11
ANSI/APSP/ICC 15—11	American National Standard for Residential Swimming Pool and Spa Energy Efficiency with Addenda A approved January 9, 2013	R403.12

ARDM

Association of Refrigerant Desuperheater Manufacturers, Inc.
c/o Doucette Industries
4151 112 Terrace N
Clearwater, FL 33762

Standard reference number	Title	Referenced in code section number
ARDM—88	Residential Heat Recovery Installation Guide, First Edition	R405.7.7

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329-2305

Standard reference number	Title	Referenced in code section number
ANSI/ASHRAE Std. 62.2-10	Ventilation for Acceptable Indoor Air Quality	R403.6.2, Table R405.5.2(1)
ASHRAE—2013	ASHRAE Handbook of Fundamentals	R402.1.5, Table R405.5.2(1)
ASHRAE 193—2010	Method of Test for Determining the Airtightness of HVAC Equipment	R403.3.2.1

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

Standard reference number	Title	Referenced in code section number
C36/C36M—03	Standard Specification for Gypsum Wallboard	R202
C272—01	Test Method for Water Absorption of Core Materials for Structural Sandwich Construction	R303.2.1.3
C516—08	Vermiculite Loose Fill Thermal Insulation	Table R303.2.1
C549—06	Perlite Loose Fill Insulation	Table R303.2.1
C578—08b	Rigid, Cellular Polystyrene Thermal Insulation	Table R303.2.1
C665—06	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing	Table R303.2.1
C727—01	Standard Practice for Installation and Use of Reflective Insulation in Building Constructions	Table R303.2.1
C739—08	Cellulosic Fiber Loose-Fill Thermal Insulation	Table R303.2.1
C764—07	Mineral Fiber Loose-Fill Thermal Insulation	Table R303.2.1
C1015—06	Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation	Table R303.2.1
C1029—08	Specification for Spray-applied Rigid Cellular Polyurethane Thermal Insulation	Table R303.2.1
C1158—05	Standard Practice for Use and Installation of Radiant Barrier Systems (RBS) in Building Construction	Table R303.2.1, R405.7.1
C1224—03	Reflective Insulation for Building Applications	Table R303.2
C1289—08	Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board	Table 303.2
C1313—05	Sheet Radiant Barriers for Building Construction Applications	Table R303.2.1, R405.7.1
C1320—05	Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light-frame Construction	Table R303.2.1
C1321—04	Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCC) in Building Construction	Table R303.2.1, Table R303.2, R405.7.1
C1363—11	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	R303.1.1.1.3

ASTM—continued

C1371—04a	Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers	R405.7.1, R405.7.2
C1549—04	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflector.	R405.7.2
E283—04	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.	R402.4.4, Appendix RD
E779—10	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.	R402.4.1.2
E903—96	Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres	R405.7.2
E1827—11	Standard Test Methods for Determining Airtightness of Building Using an Orifice Blower Door	R402.4.1.2
E1918—06	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-sloped Surfaces in the Field	R405.7.2

CRRC

Cool Roof Rating Council
449 15th Street, Suite 400
Oakland, CA 94612

Standard reference number	Title	Referenced in code section number
CRRC-1—2006	CRRC-1 Product Rating Program	R405.7.2

CSA

CSA Group
8501 East Pleasant Valley Road
Cleveland, OH 44131-5516

Standard reference number	Title	Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A440—11	North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights	R402.4.3
CSA 55.1—2012	Test Method for measuring efficiency and pressure loss of drain water heat recovery units	R403.5.4
CSA 55.2—2012	Drain water heat recover units	R403.5.4

DASMA

Door & Access Systems Manufacturers Association International
1300 Sumner Avenue
Cleveland, OH 44115-2851

Standard reference number	Title	Referenced in code section number
105—92(R2004)—13	Test Method for Thermal Transmittance and Air Infiltration of Garage Doors.	R303.1.3

EPCOT Codes

Reedy Creek Improvement District
P.O. Box 10170
Lake Buena Vista, FL 32830

Standard reference number	Title	Referenced in code section number
EBC—Sixteenth Edition (2018)	EPCOT Building Code.	R201.3, R202, R303.2, R402.1.1, Table R402.1.2, R402.2.11, R402.4.4, R405.7.1, R405.7.3, R501.4
EFGC—Thirteenth Edition (2018)	EPCOT Fuel Gas Code.	R201.3, R501.4
EFPC—Tenth Edition (2018)	EPCOT Fire Prevention Code	R201.3, R501.4, RB103.3
EMC—Fourteenth Edition (2018)	EPCOT Mechanical	R201.3, R403.6, R501.4
EPC—Fifteenth Edition (2018)	EPCOT Plumbing Code	R201.3, R501.4

REFERENCED STANDARDS

Florida Codes

Building Codes and Standards Office
Florida Department of Business and Professional Regulation
1940 N Monroe Street, Suite 90A
Tallahassee, FL 32399-0772

Standard reference number	Title	Referenced in code section number
FFPC—Sixth Edition (2017)	Florida Fire Prevention Code	R201.3
FS	Florida Statutes	R103.1.1.1.2, R103.1.1.2, R104.4, R401.3, R402.4.1.2, R403.3.2, R406.5

FSEC

Florida Solar Energy Center
1679 Clearlake Road
Cocoa, FL 32922-5703

Standard reference number	Title	Referenced in code section number
FSEC-RR-54-00	“The HERS Rating Method and the Derivation of the Normalized Modified Loads Method”, October 11, 2000, Fairey, P., J. Tait, D. Goldstein, D. Tracey, M. Holtz, and R. Judkoff	Appendix RC, C-1
	Available online at: http://www2.fsec.ucf.edu/en/publications/html/FSEC-RR-54-00/index.html	

ICC

International Code Council, Inc.
500 New Jersey Avenue, NW
6th Floor
Washington, DC 20001

Standard reference number	Title	Referenced in code section number
ICC 400—12	Standard on the Design and Construction of Log Structures	Table R402.5.1.1
IECC—15	International Energy Conservation Code®	R406.2
IECC—09	2009 International Energy Conservation Code®	R406.2
ECC—06	2006 International Energy Conservation Code®	R202, R406.3.1

IEEE

The Institute of Electrical and Electronic Engineers, Inc.
3 Park Avenue, 17th Floor
New York, NY 10016-5997

Standard reference number	Title	Referenced in code section number
515.1—2012	IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications	R403.5.1.2

ISO

International Organization for Standardization
Chemin de Blandonnet 8
CP 401
1214 Vernier
Geneva, Switzerland

Standard reference number	Title	Referenced in code section number
9806 (1994, 1995)	TEST Methods for Solar Collectors Part 1: Thermal performance of glazed liquid heating collectors including pressure drop, December 1, 1994 Part 2: Qualification test procedures, August 15, 1995 Part 3: Thermal performance of unglazed liquid heating collectors (sensible heat transfer only) including pressure drop, December 15, 1995	R403.5.6.2.1

NFPA

National Fire Protection Association.
1 Batterymarch Park
Quincy, MA 02169-7471

Standard reference number	Title	Referenced in code section number
70—14	National Electrical Code	R501.4

NFRC

National Fenestration Rating Council, Inc.
6305 Ivy Lane, Suite 140
Greenbelt, MD 20770

Standard reference number	Title	Referenced in code section number
100—2009	Procedure for Determining Fenestration Products <i>U</i> -factors—Second Edition	R303.1.3
200—2009	Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence—Second Edition	R303.1.3
400—2009	Procedure for Determining Fenestration Product Air Leakage—Second Edition	R402.4.3

SRCC

Solar Rating and Certification Corporation
c/o Florida Solar Energy Center
1679 Clearlake Road
Cocoa, FL 32922-5703

Standard reference number	Title	Referenced in code section number
FSEC	Directory of Certified Solar Systems	R403.5.6.2.1
SRCC TM-1	Solar Domestic Hot Water System and Component Test Protocol, December 6, 2002	R403.5.6.2.1

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

Standard reference number	Title	Referenced in code section number
127—11	Standard for Factory Built Fireplaces	R402.4.2
515—11	Electrical Resistance Heat Tracing for Commercial and Industrial Applications including revisions through November 30, 2011	R403.5.1.2

REFERENCED STANDARDS

US-FTC

United States-Federal Trade Commission
600 Pennsylvania Avenue NW
Washington, DC 20580

Standard reference number	Title	Referenced in code section number
CFR Title 16, Part 460	R-value Rule	R303.1.1.1, R303.1.1.2

WDMA

Window and Door Manufacturers Association
2025 M Street NW, Suite 800
Washington, DC 20036-3309

Standard reference number	Title	Referenced in code section number
AAMA/WDMA/CSA 101/I.S.2/A440—11	North American Fenestration Standard/Specification for Windows, Doors and Unit Skylights	R402.4.3

APPENDIX RA

RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS UNDER R402.4 OR R405 CONDITIONS $\leq 5 \text{ ACH}_{50}$

(This appendix is informative and is not part of the code.)

SECTION RA101 SCOPE

RA101.1 General. This appendix is intended to provide guidelines for worst-case testing of atmospheric venting systems. Worst-case testing is recommended to identify problems that weaken draft and restrict combustion air.

SECTION RA201 GENERAL DEFINITIONS

COMBUSTION APPLIANCE ZONE (CAZ). A contiguous air volume within a building that contains a Category I or II atmospherically vented appliance or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside the building or dwelling unit. The CAZ includes, but is not limited to, a mechanical closet, a mechanical room, or the main body of a house or dwelling unit.

DRAFT. The pressure difference existing between the appliance or any component part and the atmosphere that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.

Mechanical or induced draft. The pressure difference created by the action of a fan, blower or ejector that is located between the appliance and the chimney or vent termination.

Natural draft. The pressure difference created by a vent or chimney because of its height and the temperature difference between the flue gases and the atmosphere.

SPILLAGE. Combustion gases emerging from an appliance or venting system into the combustion appliance zone during burner operation.

SECTION RA301 TESTING PROCEDURE

RA301.1 Worst-case testing of atmospheric venting systems. Buildings or dwelling units containing a Category I or II atmospherically vented appliance; or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside of the building or dwelling unit, shall have the Combustion Appliance Zone (CAZ) tested for spillage, acceptable draft and carbon monoxide (CO) in accordance with this Section. Where required by the Building Official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the Building Official. Testing shall be performed at any time after creation of all penetra-

tions of the building thermal envelope and prior to final inspection.

Exception: Buildings or dwelling units containing only Category III or IV direct-vent or integral vent appliances that do not draw combustion air from inside of the building or dwelling unit.

The enumerated test procedure as follows shall be complied with during testing:

1. Set combustion appliances to the pilot setting or turn off the service disconnects for combustion appliances. Close exterior doors and windows and the fireplace damper. With the building or dwelling unit in this configuration, measure and record the baseline ambient pressure inside the building or dwelling unit CAZ. Compare the baseline ambient pressure of the CAZ to that of the outside ambient pressure and record the difference (Pa).
2. Establish worst case by turning on the clothes dryer and all exhaust fans. Close all interior doors that make the CAZ pressure more negative. Turn on the air handler, where present, and leave on if, as a result, the pressure in the CAZ becomes more negative. Check interior door positions again, closing only the interior doors that make the CAZ pressure more negative. Measure net change in pressure from the CAZ to outdoor ambient pressure, correcting for the base ambient pressure inside the home. Record "worst case depressurization" pressure and compare to Table RA301.1(1).

Where CAZ depressurization limits are exceeded under worst-case conditions in accordance with Table A301.1(1), additional combustion air shall be provided or other modifications to building air-leakage performance or exhaust appliances such that depressurization is brought within the limits prescribed in Table RA301.1(1).

3. Measure worst-case spillage, acceptable draft and carbon monoxide (CO) by firing the fuel-fired appliance with the smallest Btu capacity first.
 - a. Test for spillage at the draft diverter with a mirror or smoke puffer. An appliance that continues to spill flue gases for more than 60 seconds fails the spillage test.
 - b. Test for CO measuring undiluted flue gases in the throat or flue of the appliance using a digital gauge in parts per million (ppm) at the 10-minute mark. Record CO ppm readings to be compared with Table

APPENDIX RA—RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS UNDER R402.4 OR R405 CONDITIONS $\leq 5 \text{ ACH}_{50}$

RA301.1(3) upon completion of Step 4. Where the spillage test fails under worst case, go to Step 4.

- c. Where spillage ends within 60 seconds, test for acceptable draft in the connector not less than 1 foot (305 mm), but not more than 2 feet (610 mm) downstream of the draft diverter. Record draft pressure and compare to Table RA301.1(2).
 - d. Fire all other connected appliances simultaneously and test again at the draft diverter of each appliance for spillage, CO and acceptable draft using procedures 3a through 3c.
4. Measure spillage, acceptable draft, and carbon monoxide (CO) under natural conditions—without clothes dryer and exhaust fans on—in accordance with the procedure outlined in Step 3, measuring the net change in

pressure from worst case condition in Step 3 to natural in the CAZ to confirm the worst case depressurization taken in Step 2. Repeat the process for each appliance, allowing each vent system to cool between tests.

5. Monitor indoor ambient CO in the breathing zone continuously during testing, and abort the test where indoor ambient CO exceeds 35 ppm by turning off the appliance, ventilating the space, and evacuating the building. The CO problem shall be corrected prior to completing combustion safety diagnostics.
6. Make recommendations based on test results and the retrofit action prescribed in Table RA301.1(3).

**TABLE RA301.1(1)
CAZ DEPRESSURIZATION LIMITS**

VENTING CONDITION	LIMIT (Pa)
Category I, atmospherically vented water heater	−2.0
Category I or II atmospherically vented boiler or furnace common-vented with a Category I atmospherically vented water heater	−3.0
Category I or II atmospherically vented boiler or furnace, equipped with a flue damper, and common vented with a Category I atmospherically vented water heater	−5.0
Category I or II atmospherically vented boiler or furnace alone	
Category I or II atmospherically vented, fan-assisted boiler or furnace common vented with a Category I atmospherically vented water heater	
Decorative vented, gas appliance	
Power-vented or induced-draft boiler or furnace alone, or fan-assisted water heater alone	−15.0
Category IV direct-vented appliances and sealed combustion appliances	−50.0

For SI: 6894.76 Pa = 1.0 psi.

**TABLE RA301.1(2)
ACCEPTABLE DRAFT TEST CORRECTION**

OUTSIDE TEMPERATURE (°F)	MINIMUM DRAFT PRESSURE REQUIRED (Pa)
< 10	−2.5
10 – 90	(Outside Temperature ÷ 40) – 2.75
> 90	−0.5

For SI: 6894.76 Pa = 1.0 psi.

**TABLE RA301.1(3)
ACCEPTABLE DRAFT TEST CORRECTION**

CARBON MONOXIDE LEVEL (ppm)	AND OR	SPILLAGE AND ACCEPTABLE DRAFT TEST RESULTS	RETROFIT ACTION
0 – 25	and	Passes	Proceed with work
25 < x ≤ 100	and	Passes	Recommend that CO problem be resolved
25 < x ≤ 100	and	Fails in worst case only	Recommend an appliance service call and repairs to resolve the problem
100 < x ≤ 400	or	Fails under natural conditions	Stop! Work shall not proceed until appliance is serviced and problem resolved
> 400	and	Passes	Stop! Work shall not proceed until appliance is serviced and problem resolved
> 400	and	Fails under any condition	Emergency! Shut off fuel to appliance and call for service immediately

APPENDIX RB

SOLAR-READY PROVISIONS—DETACHED ONE- AND TWO-FAMILY DWELLINGS, MULTIPLE SINGLE-FAMILY DWELLINGS (TOWNHOUSES)

(The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.)

SECTION RB101 SCOPE

RB101.1 General. These provisions shall be applicable for new construction where solar-ready provisions are required.

SECTION RB102 GENERAL DEFINITION

SOLAR-READY ZONE. A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

SECTION RB103 SOLAR-READY ZONE

RB103.1 General. New detached one- and two-family dwellings, and multiple single-family dwellings (townhouses) with not less than 600 square feet (55.74 m²) of roof area oriented between 110 degrees and 270 degrees of true north shall comply with Subsections RB103.2 through RB103.8.

Exceptions:

1. New residential buildings with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone that is shaded for more than 70 percent of daylight hours annually.

RB103.2 Construction document requirements for solar-ready zone. Construction documents shall indicate the solar-ready zone.

RB103.3 Solar-ready zone area. The total solar-ready zone area shall be not less than 300 square feet (27.87 m²) exclusive of mandatory access or set back areas as required by the *EPCOT Fire Prevention Code*. New multiple single-family dwellings (townhouses) three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (185.8 m²) per dwelling shall have a solar-ready zone area of not less than 150 square feet (13.94 m²). The solar-ready zone shall be composed of areas not less than 5 feet (1524 mm) in width and not less than 80 square feet (7.44 m²) exclusive of access or set back areas as required by the *EPCOT Fire Prevention Code*.

RB103.4 Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

RB103.5 Roof load documentation. The structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents.

RB103.6 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or plumbing from the solar-ready zone to the electrical service panel or service hot water system.

RB103.7 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled “For Future Solar Electric.” The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

RB103.8 Construction documentation certificate. A permanent certificate, indicating the solar-ready zone and other requirements of this Section, shall be posted near the electrical distribution panel, water heater or other conspicuous location by the builder or registered design professional.

APPENDIX RC

CALCULATION OF END USE ENERGY LOADS

RC-1 Calculation of end use energy loads for code compliance determination. The energy loads for heating, cooling and hot water in the *Proposed Design* home shall be normalized to account for the differences in improvement potential that exist across equipment types using the following formula in accordance with the paper “The HERS Rating Method and the Derivation of the Normalized Modified Loads Method,” Research Report No. FSEC-RR-54-00, Florida Solar Energy Center.

$$nMEUL = REUL * (nEC_x / EC_r)$$

where:

nMEUL = normalized Modified End Use Loads (for heating, cooling or hot water) as computed using Commission-approved compliance software.

REUL = *Standard Reference Design* home End Use Loads (for heating, cooling or hot water) as computed using Commission-approved compliance software.

EC_r = estimated Energy Consumption for the *Standard Reference Design* home’s end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using Commission-approved compliance software.

and where:

$$nEC_x = (a * EEC_x - b) * (EC_x * EC_r * DSE_r) / (EEC_x * REUL)$$

where:

nEC_x = normalized Energy Consumption for *Proposed Design*’s end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using Commission-approved compliance software.

EC_r = estimated Energy Consumption for *Standard Reference Design* home’s end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using Commission-approved compliance software.

EC_x = estimated Energy Consumption for the *Proposed Design* home’s end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using Commission-approved compliance software.

EEC_x = Equipment Efficiency Coefficient for the *Standard Reference Design* home’s equipment, such that EEC_x = the energy consumption per unit load in like units as the load, and as derived from the Manufacturer’s Equipment Performance Rating (MEPR) such that EEC_x = 1.0 / MEPR for AFUE, COP or EF ratings, or such

that EEC_x equals 3.413/MEPR for HSPF, EER or SEER ratings.

$$DSE_r = REUL / EC_r * EEC_r$$

For simplified system performance methods, DSE_r equals 0.80 for heating and cooling systems. However, for detailed modeling of heating and cooling systems, DSE_r may be less than 0.80 as a result of part load performance degradation, coil airflow degradation, improper system charge and auxiliary resistance heating for heat pumps. Except as otherwise provided by these Standards, where detailed systems modeling is employed, it must be applied equally to both the *Standard Reference Design* and the *Proposed Design* homes.

EEC_r = Equipment Efficiency Coefficient for the *Standard Reference Design* home’s equipment, such that EEC_r equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer’s Equipment Performance Rating (MEPR) such that EEC_r equals 1.0/MEPR for AFUE, COP or EF ratings, or such that EEC_r equals 3.413/ MEPR for HSPF, EER or SEER ratings.

REUL = *Standard Reference Design* home End Use Loads (for heating or cooling) as computed using Commission-approved compliance software.

and where the coefficients ‘a’ and ‘b’ are as defined by Table RC-1(1).

TABLE RC-1(1) COEFFICIENTS ‘a’ AND ‘b’

FUEL TYPE AND END USE	a	b
Electric space heating	2.4026	0.0000
Fossil fuel* space heating	1.0370	0.2962
Biomass space heating	0.7297	0.1583
Electric air conditioning	4.1020	0.0000
Electric water heating	0.9500	0.0000
Fossil fuel* water heating	1.3774	1.2217
* Such as natural gas, LP, fuel oil		

RC-2 Following normalization of the heating, cooling and hot water energy consumptions for the *Proposed Design* as specified in Section RC-1 above, the *Standard Reference Design* home’s total reference end use loads for heating, cooling and hot water (REULtot) shall be compared with the *Proposed Design* home’s total normalized modified end use loads for heating, cooling and hot water (nMEULtot). If the total normalized modified loads of the Proposed Design home (nMEULtot) are equal to or less than the total reference loads of the *Standard Reference Design* home (REULtot), the *Proposed Design* complies with this Code.

APPENDIX RD

FORMS

ENERGY PERFORMANCE LEVEL (EPL) DISPLAY CARD

ESTIMATED ENERGY PERFORMANCE INDEX* = _____

The lower the Energy Performance Index, the more efficient the home.

1. New home or, addition	1. _____	12. Ducts, location & insulation level	
2. Single-family or multiple-family	2. _____	a) Supply ducts	R= _____
3. No. of units (if multiple-family)	3. _____	b) Return ducts	R= _____
4. Number of bedrooms	4. _____	c) AHU location	
5. Is this a worst case? (yes/no)	5. _____	13. Cooling system:	Capacity: _____
6. Conditioned floor area (sq. ft.)	6. _____	a) Split system	SEER _____
7. Windows, type and area		b) Single package	SEER _____
a) U-factor:	7a. _____	c) Ground/water source	COP _____
b) Solar Heat Gain Coefficient (SHGC)	7b. _____	d) Room unit/PTAC	EER _____
c) Area	7c. _____	e) Other _____	_____
8. Skylights		14. Heating system:	
a) U-factor	8a. _____	a) Split system heat pump	HSPF _____
b) Solar Heat Gain Coefficient (SHGC)	8b. _____	b) Single package heat pump	HSPF _____
9. Floor type, insulation level:		c) Electric resistance	COP _____
a) Slab-on-grade (R-value)	9a. _____	d) Gas furnace, natural gas	AFUE _____
b) Wood, raised (R-value)	9b. _____	e) Gas furnace, LPG	AFUE _____
c) Concrete, raised (R-value)	9c. _____	f) Other _____	_____
10. Wall type and insulation:		15. Water heating system	
A. Exterior:		a) Electric resistance	EF _____
1. Wood frame (Insulation R-value)	10A1. _____	b) Gas fired, natural gas	EF _____
2. Masonry (Insulation R-value)	10A2. _____	c) Gas fired, LPG	EF _____
B. Adjacent:		d) Solar system with tank	EF _____
1. Wood frame (Insulation R-value)	10B1. _____	e) Dedicated heat pump with tank	EF _____
2. Masonry (Insulation R-value)	10B2. _____	f) Heat recovery unit	HeatRec% _____
11. Ceiling type and insulation level		g) Other _____	_____
a) Under attic	11a. _____	16. HVAC credits claimed (Performance Method)	_____
b) Single assembly	11b. _____	a) Ceiling fans	_____
c) Knee walls/skylight walls	11c. _____	b) Cross ventilation	_____
d) Radiant barrier installed	11d. _____	c) Whole house fan	_____
		d) Multizone cooling credit	_____
		e) Multizone heating credit	_____
		f) Programmable thermostat	_____

*Label required by Subsection R303.1.3 of the *EPCOT Energy Efficiency Code*, if not DEFAULT.

I certify that this home has complied with the *EPCOT Energy Efficiency Code*, through the above energy saving features which will be installed (or exceeded) in this home before final inspection. Otherwise, a new EPL display card will be completed based on installed code compliant features.

Builder Signature: _____

Date: _____

Address of New Home: _____

City/FL Zip: _____

FORM R400D-2017
DESUPERHEATER, HEAT RECOVERY UNIT (HRU) WATER HEATER
EFFICIENCY CERTIFICATION
TESTS CONDUCTED IN ACCORDANCE WITH
AHRI STANDARD 470

Laboratory: _____ Date of Test: _____

Report Approved By: _____ Report No: _____

Manufacturer: _____ Model No: _____

Construction Type: _____

Recommended for use with refrigeration system capacities of _____ tons.

Design Pressure: _____ Water side: _____ psig

Refrigerant side: _____ psig

Test results at Standard Conditions:

Test refrigerant designation: _____

Tested at system capacity: _____ tons

Total system hot gas superheat: _____ Btu/h

Total useful heat exchange effect: _____ Btu/h

Water pump input: _____ watts

NET SUPERHEAT RECOVERY: _____ %

EPCOT ENERGY EFFICIENCY CODE FOR BUILDING CONSTRUCTION**Residential Building Thermal Envelope Approach****FORM R402-2017****Climate Zone ☐**

Scope: Compliance with Subsection R401.2(1) of the *EPCOT Energy Efficiency Code*, shall be demonstrated by the use of Form R402 for single- and multiple-family residences of three stories or less in height, additions to existing residential buildings, alterations, renovations and building systems in existing buildings, as applicable. To comply, a building must meet or exceed all of the energy efficiency requirements on Table R402A and all applicable mandatory requirements summarized in Table R402B of this form. If a building does not comply with this method, or by the UA Alternative method, it may still comply under Section R405 of the *EPCOT Energy Efficiency Code*.

**PROJECT NAME
AND ADDRESS:****BUILDER:****OWNER:****PERMITTING OFFICE:****JURISDICTION NUMBER:****PERMIT NUMBER:****General Instructions:**

1. Fill in all the applicable spaces of the "To Be Installed" column on Table R402A with the information requested. All "To Be Installed" values must be equal to or more efficient than the required levels.
2. Complete page 1 based on the "To Be Installed" column information.
3. Read the requirements of Table R402B and check each box to indicate your intent to comply with all applicable items.
4. Read, sign and date the "Prepared By" certification statement at the bottom of page 1. The owner or owner's agent must also sign and date the form.

1. New construction, addition, or existing building	1. _____	_____
2. Single-family detached or multiple-family attached	2. _____	_____
3. If multiple-family, number of units covered by this submission	3. _____	_____
4. Is this a worst case? (yes/no)	4. _____	_____
5. Conditioned floor area (sq. ft.)	5. _____	_____
6. Windows, type and area		
a) U-factor:	6a. _____	_____
b) Solar Heat Gain Coefficient (SHGC)	6b. _____	_____
c) Area	6c. _____	_____
7. Skylights		
a) U-factor:	7a. _____	_____
b) Solar Heat Gain Coefficient (SHGC)	7b. _____	_____
8. Floor type, area or perimeter, and insulation:		
a) Slab-on-grade (R-value)	8a. _____	_____
b) Wood, raised (R-value)	8b. _____	_____
c) Wood, common (R-value)	8c. _____	_____
d) Concrete, raised (R-value)	8d. _____	_____
e) Concrete, common (R-value)	8e. _____	_____
9. Wall type and insulation:		
a) Exterior: 1. Wood frame (Insulation R-value)	9a1. _____	_____
2. Masonry (Insulation R-value)	9a2. _____	_____
b) Adjacent: 1. Wood frame (Insulation R-value)	9b1. _____	_____
2. Masonry (Insulation R-value)	9b2. _____	_____
10. Ceiling type and insulation		
a) Attic (Insulation R-value)	10a. _____	_____
b) Single assembly (Insulation R-value)	10b. _____	_____
11. Air distribution system:		
a) Duct location, insulation	11a. _____	_____
b) AHU location	11b. _____	_____
c) Total duct leakage. Test report attached.	11c. _____ cfm/100 s.f.	Yes <input type="checkbox"/> No <input type="checkbox"/>
12. Cooling system:		
a) type	12a. _____	_____
b) efficiency	12b. _____	_____
13. Heating system:		
a) type	13a. _____	_____
b) efficiency	13b. _____	_____
14. HVAC sizing calculation: attached	14. _____	Yes <input type="checkbox"/> No <input type="checkbox"/>
15. Water heating system:		
a) type	15a. _____	_____
b) efficiency	15b. _____	_____

I hereby certify that the plans and specifications covered by this form are in compliance with the *EPCOT Energy Efficiency Code*.

PREPARED BY: _____ Date: _____

I hereby certify that this building is in compliance with the *EPCOT Energy Efficiency Code*.

OWNER/AGENT: _____ Date: _____

Review of plans and specifications covered by this form indicate compliance with the *EPCOT Energy Efficiency Code*. Before construction is complete, this building will be inspected for compliance in accordance with Section 553.908, F.S.

BUILDING OFFICIAL: _____

Date: _____

TABLE R402A

BUILDING COMPONENT	PRESCRIPTIVE REQUIREMENTS ¹		INSTALLED VALUES
	Climate Zone 1	Climate Zone 2	
Windows Skylights	U -Factor = NR SHGC = 0.25 U -factor = 0.75 SHGC = 0.30	U -Factor = 0.40 ² SHGC = 0.25 U -factor = 0.65 SHGC = 0.30	U -Factor = SHGC = U -factor = SHGC =
Doors: Exterior door	U -factor = NR	U -factor = 0.40 ³	U -factor =
Floors: Slab-on-Grade Over unconditioned spaces ⁴	NR R-13	NR R-13	R-Value =
Walls ⁴ : Ext. and Adj. Frame Mass Insulation on wall interior Insulation on wall exterior	R-13 R-4 R-3	R-13 R-6 R-4	R-Value = R-Value = R-Value =
Ceilings ⁵	R=30	R=38	R-Value =
Air infiltration	Blower door test is required on the building envelope to verify leakage ≤ 7 ACH; test report provided to Building Official.		Total leakage = ACH Test report attached? Yes <input type="checkbox"/> No <input type="checkbox"/>
Air distribution system ⁵ : Air handling unit Duct R-value Air leakage ⁵ : Duct test Ducts in conditioned space	Not allowed in attic R-value \geq R-8 (supply in attics) or \geq R-6 (all other duct locations) Postconstruction test Total leakage ≤ 4 cfm/100 s.f. Rough-in test Total leakage ≤ 4 cfm/100 s.f. (air handler installed) Total leakage ≤ 3 cfm/100 s.f. (air handler not installed) Test not required if all ducts and AHU are in conditioned space		Location: R-Value = Total leakage = _____ cfm/100s.f. Test report Attached? Yes <input type="checkbox"/> No <input type="checkbox"/> Location:
Air conditioning system: Central system $\leq 65,000$ Btu/h Room unit or PTAC Other:	Minimum federal standard required by NAECA ⁶ : SEER 14.0 EER [from Table C403.2.3(3)] See Tables C403.2.3(1)-(11)		SEER = EER =
Heating system: Heat pump $\leq 65,000$ Btu/h Gas furnace, non-weatherized Oil furnace, non-weatherized Other:	Minimum federal standard required by NAECA ⁶ : HSPF 8.2 AFUE 80% AFUE 83%		HSPF = AFUE = AFUE =
Water heating system (storage type): Electric ⁷ Gas fired ⁸ Other (describe):	Minimum federal standard required by NAECA ⁶ : 40 gal: EF = 0.92 50 gal: EF = 0.90 40 gal: EF = 0.59 50 gal: EF = 0.58		Gallons = EF = Gallons = EF =

NR = No requirement.

- (1) Each component present in the As Proposed home must meet or exceed each of the applicable performance criteria in order to comply with this Code using this method.
- (2) For impact rated fenestration complying with the *EPCOT Building Code*, the maximum U -factor shall be 0.65 in Climate Zone 2. An area-weighted average of U -factor and SHGC shall be accepted to meet the requirements, or up to 15 square feet of glazed fenestration area are exempted from the U -factor and SHGC requirement based on Subsections R402.3.1, R402.3.2 and R402.3.3.
- (3) One side-hinged opaque door assembly up to 24 square feet is exempted from this U -factor requirement.
- (4) R-values are for insulation material only as applied in accordance with manufacturer's installation instructions. For mass walls, the "interior of wall" requirement must be met except if at least 50 percent of the insulation required for the "exterior of wall" is installed exterior of, or integral to, the wall.
- (5) Ducts & AHU installed "substantially leak free" per Subsection R403.2.2. Test required by either individuals as defined in Section 553.993(5) or (7), *Florida Statutes*, or individuals licensed as set forth in Section 489.105(3)(f), (g) or (i), *Florida Statutes*. The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.
- (6) Minimum efficiencies are those set by the *National Appliance Energy Conservation Act* of 1987 for typical residential equipment and are subject to NAECA rules and regulations. For other types of equipment, see Tables C403.2.3(1-11) of the Commercial Provisions of the *EPCOT Energy Efficiency Code*.
- (7) For other electric storage volumes, minimum EF = 0.97 - (0.00132 * volume).
- (8) For other natural gas storage volumes, minimum EF = 0.67 - (0.0019 * volume).

TABLE R402B MANDATORY REQUIREMENTS			
Component	Section	Summary of Requirement(s)	Check
Air leakage	R402.4	To be caulked, gasketed, weatherstripped or otherwise sealed per Table R402.4.1.1. Recessed lighting: IC-rated as having ≤ 2.0 cfm tested to ASTM E 283. Windows and doors: 0.3 cfm/sq. ft. (swinging doors: 0.5 cfm/sf) when tested to NFRC 400 or AAMA/WDMA/CSA 101/I.S. 2/A440. Fireplaces: Tight-fitting flue dampers & outdoor combustion air.	
Programmable thermostat	R403.1.2	A programmable thermostat is required for the primary heating or cooling system.	
Air distribution system	R403.3.2 R403.3.4	Ducts shall be tested as per Subsection R403.3.2 by either individuals as defined in Section 553.993(5) or (7), <i>Florida Statutes</i> , or individuals licensed as set forth in Section 489.105(3) (f), (g) or (i), <i>Florida Statutes</i> . Air handling units are not allowed in attics.	
Water heaters	R403.5	Comply with efficiencies in Table C404.2. Hot water pipes insulated to $\geq R-3$ to kitchen outlets, other cases. Circulating systems to have an automatic or accessible manual OFF switch. Heat trap required for vertical pipe risers.	
Swimming pools & spas	R403.10	Spas and heated pools must have vapor-retardant covers or a liquid cover or other means proven to reduce heat loss except if 70% of heat from site-recovered energy. Off/timer switch required. Gas heaters minimum thermal efficiency is 82%. Heat pump pool heaters minimum COP is 4.0.	
Cooling/heating equipment	R403.7	Sizing calculation performed & attached. Special occasion cooling or heating capacity requires separate system or variable capacity system.	
Lighting equipment	R404.1	At least 75% of permanently installed lighting fixtures shall be high-efficacy lamps.	

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EPCOT

FIRE PREVENTION CODE

2018 EDITION

AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT

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FOREWORD

The purpose of the *EPCOT Fire Prevention Code*® is to serve as a comprehensive regulatory document to guide decisions aimed at protecting the public's life, health, safety and welfare in the built environment. This protection is provided through the adoption and enforcement of the performance-based provisions contained herein.

The use of performance-based requirements encourages the use of innovative building designs, materials and construction systems, while at the same time recognizing the merits of the more traditional materials and systems. This concept promotes maximum flexibility in building design and construction, as well as assuring a high degree of life safety.

The *EPCOT Fire Prevention Code* incorporates, by reference, nationally recognized consensus standards for use in judging the performance of materials and systems. This provides for the equal treatment of both innovative and traditional materials and systems, provides for the efficient introduction of new materials into the construction process and assures a high level of consumer protection.

PREFACE

Introduction

Internationally, Code Officials recognize the need for a modern, up-to-date *fire prevention* code addressing the design and installation of systems through requirements emphasizing performance. The *EPCOT Fire Prevention Code* is designed to meet these needs through model code regulations that safeguard the public's health and safety in all communities, large and small.

This comprehensive *fire prevention* code establishes minimum regulations for systems using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new system designs.

Marginal Markings

Solid vertical lines in the margins within the body of this Code indicate a change from the requirements of the 2015 edition, except where a change was minor. Deletion indicators (➡) are provided in the margin where *an entire section*, paragraph, *exception or table* has been deleted if the deletion resulted in a change of requirements.

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CHAPTER 1

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101.2 Legality. The *Florida Fire Prevention Code*, as adopted by Florida State Statute 633.20, is legally a part of this Code and their provisions shall be enforced by the Fire Official. Any reference to the *EPCOT Fire Prevention Code* shall be deemed a reference to the *Florida Fire Prevention Code*.

EPCOT

FUEL GAS CODE 2018 EDITION

AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT

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The use of performance-based requirements encourages the use of innovative building designs, materials and construction systems, while at the same time recognizing the merits of the more traditional materials and systems. This concept promotes maximum flexibility in building design and construction, as well as assuring a high degree of life safety.

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Internationally, Code Officials recognize the need for a modern, up-to-date *gas* code addressing the design and installation of gas systems through requirements emphasizing performance. The *EPCOT Fuel Gas Code* is designed to meet these needs through model code regulations that safeguard the public's health and safety in all communities, large and small.

This comprehensive *gas* code establishes minimum regulations for *gas* systems using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new *gas* system designs.

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CHAPTER 1

ADMINISTRATION

SECTION 101 TITLE AND SCOPE

101.1 Title. The provisions in the following Chapters and Sections of this volume, together with the Appendices, shall constitute and be known as “The *EPCOT Fuel Gas Code*,” hereafter referred to as “this Code.”

101.2 Code remedial. This Code is hereby declared to be remedial and shall be construed to secure the beneficial interest and purposes thereof by regulating the installation and maintenance of all consumers’ gas piping and gas appliances within the Reedy Creek Improvement District (the District).

101.3 Scope. The provisions of this Code shall govern the installation of consumers’ gas piping and gas appliances. These requirements apply to gas piping systems extending from the point of delivery at the street line, property boundary or meter, to the inlet connections of appliances; and the installation, tests and operation of such systems for fuel gases such as natural gas, manufactured gas, undiluted liquefied petroleum gases (LP gas), LP gas-air or mixtures thereof.

These requirements are not intended to cover systems or portions of systems for specific manufacturing, production processing and power generation applications, such as large and high-pressure boilers, melting and treating furnaces, production ovens, etc.; or for public utility piping in gas distribution and transmission systems, gas compressing stations and gas processing plants.

101.4 Abandonment of piping and/or fittings. Abandoned piping and/or fittings shall be removed.

Exception: If it is technically infeasible to remove the pipe/fittings the pipe/fittings may be abandoned in place, at the discretion of the Chief Gas Inspector. Abandoning in place requires the pipe/fittings to be filled and sealed with grout equal to Class “C” concrete. The grout shall form a solid waterproof plug completely bonded to the pipe, and the pipe shall be permanently labeled as abandoned.

SECTION 102 WORK ON CONSUMERS’ GAS PIPING CONTAINING UNMEASURED GAS

102.1 Agency and notification. Repairs, alterations, relocation or other work on any portion of consumers’ gas piping containing unmeasured gas shall be completed by a qualified installing agency authorized to do such work. When such work is complete, the gas utility company shall be notified.

102.2 Moving meters. The moving, connection or disconnection of gas meters shall be completed by gas utility company employees or others authorized by the gas utility company to do such work.

SECTION 103 QUALIFIED INSTALLING AGENCY

103.1 Qualification requirements. Installation and replacement of consumers’ gas piping or gas appliances, and repair of consumers’ gas appliances, shall be performed only by a qualified agency. The term “qualified agency” is defined as any individual, firm, corporation or company that, either in person or through a representative, is engaged in and is responsible for the installation, replacement or repair of consumers’ gas piping; or the connection, installation, repair or servicing of gas appliances; is experienced in such work and familiar with all precautions required; and has complied with all the requirements of the Chief Gas Inspector.

SECTION 104 GENERAL PRECAUTIONS

104.1 Turn gas off. All gas piping or gas appliance installations shall be performed with the gas turned off to eliminate the hazard from leaking gas.

104.2 Notification of interrupted service. It shall be the duty of the installing agency, when the gas supply is to be turned off, to notify all affected consumers.

104.3 Before turning gas off. When two or more consumers are served from the same supply, precaution shall be exercised to ensure that only service to the proper consumer is turned off.

104.4 Checking for gas leaks. Matches, candles, flame or other sources of ignition shall not be employed to check for gas leakage. Checking for gas leakage with a soap-and-water solution is recommended. (See the provisions of Sections 311, 312 and 313.)

104.5 Use of lights. Artificial illumination, used in connection with a search for gas leakage, shall be restricted to electric hand flashlights, electrical lights controlled only by switches remote from the area of the leakage or approved safety lamps.

104.6 No smoking. When working on piping that contains or has contained gas, smoking shall not be permitted.

104.7 Handling of flammable liquids. Flammable liquids used by the installer shall be handled with proper precautions and shall not be left within the premises from the end of one working day to the beginning of the next.

104.8 Work interruptions. When interruptions in work occur, the system shall be left in a safe and satisfactory condition.

SECTION 105 ALTERNATIVE MATERIALS AND METHODS

105.1 Alternative materials and methods of installations. In cases where applicable accepted standard requirements have not been developed for a given class of appliance, accessory device, material or method of installation, approval of the Building Official shall be obtained before any such alternative material or method is installed or used. In accordance with the provisions of Section 311 of the *EPCOT Building Code*, the Building Official shall require that sufficient evidence or proof be submitted to substantiate any claim that may be made regarding its use.

SECTION 106 USE OF EXISTING PIPING AND APPLIANCES

106.1 Use of existing piping and appliances. Notwithstanding any provision in this Code to the contrary, consumers' piping installed prior to the adoption of this Code or piping installed to supply other than natural gas may be converted to natural gas, if the Chief Gas Inspector finds, upon inspection and proper tests, that such piping will render reasonably satisfactory gas service to the consumer and will not in any way endanger life or property; otherwise, such piping shall be altered or replaced, in whole or in part, to conform to the requirements of this Code.

SECTION 107 QUALIFICATION REQUIREMENTS

107.1 Qualification requirements. A person shall not engage in or work at the installation, extension or alteration of consumers' gas piping, or certain gas appliances, until such person has secured a license as provided in accordance with this Code and the *EPCOT Mechanical Code*.

SECTION 108 CHIEF GAS INSPECTOR AND ASSISTANTS

108.1 Chief gas inspector and assistants. To provide for the administration and enforcement of this Code, the Plumbing Inspection Division of the Department of Building and Safety shall be responsible to the Building Official for all gas inspections within the District.

108.2 Restriction on employees. No officer or employee connected with the Department of Building and Safety shall be financially interested in the furnishing of labor, material or appliances for the construction, alteration or maintenance of gas installations, or in the making of plans or specifications therefore, unless he is the owner of such building. No such officer or employee shall engage in any work that is inconsistent with his duties or with the interests of the Department.

SECTION 109 POWERS AND DUTIES OF THE CHIEF GAS INSPECTOR

109.1 Powers and duties of the chief gas inspector.

- (a) The Chief Gas Inspector is authorized and directed to enforce all of the provisions of this Code; and the Chief Gas Inspector or his representative, upon presentation of proper credentials, may enter any building or premises at reasonable times for the purpose of making inspections or preventing violations of this Code.
- (b) The Chief Gas Inspector is authorized to disconnect any gas piping, or fixture or appliance, that, upon inspection, is found to be defective or in such condition as to endanger life or property. In all cases where such a disconnection is made, a notice shall be attached to the piping, fixture or appliance disconnected by the Chief Gas Inspector together with the reason or reasons therefore. It shall be unlawful for any person to remove said notice or reconnect said gas piping, or fixture or appliance; in addition, said gas piping, fixture or appliance shall not be put into service or used until the Chief Gas Inspector has approved the repairs.

SECTION 110 PERMITS

110.1 Permits.

- (a) A person shall not install a gas conversion burner, floor furnace, central heating and air-conditioning unit, vented wall furnace, water heater, boiler, incinerator or consumers' gas piping, or convert existing piping to utilize fuel gas, without first obtaining a permit to do such work; however, permits will not be required for setting or connecting other gas appliances or for the repair of leaks in house piping.
- (b) The gas utility company shall not be required to obtain permits to set meters, or to extend, relocate, remove or repair its service lines, mains or other facilities.

SECTION 111 INSPECTIONS

111.1 Inspections.

- (a) Rough piping inspection shall be made after all new piping authorized by the permit has been installed, and before any such piping has been covered or concealed, or any fixtures or gas appliances have been attached thereto.
- (b) Final piping inspection shall be made after all piping authorized by the permit has been installed, and after all portions thereof, which are to be concealed, have been concealed, and before any fixtures or gas appli-

ances have been attached thereto. This inspection shall include a pressure test.

- (c) Final piping inspection shall be made on all new gas work authorized by the permit, and such portions of existing systems as may be affected by new work or any changes, to ensure compliance with all the requirements of this Code and to ensure that the installation and construction of the gas system is in accordance with the approved plans.
- (d) All tools, apparatus, labor and assistance necessary for the tests shall be furnished by the installer.
- (e) The building shall not be occupied prior to the completion of the work on said system and issuance of a Certificate of Occupancy as set forth in Section 308 of the *EPCOT Building Code*.

SECTION 112 FEES

112.1 General. No permit shall be valid until the fees prescribed in this Section have been paid; nor shall an amendment to a permit be approved until the additional fees, if required, have been paid. Permit valuations shall include total cost, whether contractor or owner furnished, such as electrical, gas, mechanical, plumbing equipment and other systems, including materials and labor.

112.2 Failure to obtain a permit. Any person who commences any work on a gas installation before obtaining the necessary permit from the District shall be subject to the penalty prescribed herein.

112.3 Issuance of permits. Upon payment of the total permit fee as determined by using the "Schedule of Building Permit Fees," as adopted by the Board of Supervisors of the District, the Chief Gas Inspector shall issue a gas permit.

SECTION 113 VIOLATIONS AND PENALTIES

113.1 Violations. Any person, firm, corporation or agent who shall violate a provision of this Code or fail to comply therewith or with any of the provisions thereof, or violate a detailed statement or plan submitted and approved thereunder, shall be guilty of a misdemeanor and shall be subject to the penalty provided in Section 67, Chapter 67-764, Laws of Florida, Special Acts of 1967.

SECTION 114 LIABILITY

114.1 Liability. Any officer or employee or member of any board charged with the enforcement of this Code, acting for the local governing body in the discharge of his duties, shall not thereby render himself liable personally and he is hereby relieved from all personal liability for any damage that may occur to persons or property as a result of any act required or permitted in the discharge of his duties. Any suit brought against any officer or employee because of such as performed by him in the enforcement of any provision of this Code shall

be defended by the legal department of the District until the final termination of the proceedings.

SECTION 115 VALIDITY

115.1 Validity. If any section, subsection, sentence, clause or phrase of this Code is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portion of this Code.

CHAPTER 2

DEFINITIONS

SECTION 201 GENERAL

201.1 Scope. For the purpose of this Code, certain abbreviations, terms, phrases, words and their derivatives shall be construed as set forth in this chapter.

201.2 Tense, gender and number. Words used in the present tense include the future. Words in the masculine gender include the feminine and neuter. Words in the feminine and neuter gender include the masculine. The singular number includes the plural and the plural number includes the singular.

201.3 Terms not defined. Terms not defined herein shall have the meanings stated in the *EPCOT Building Code*, the *EPCOT Mechanical Code*, the *EPCOT Plumbing Code* or the *EPCOT Fire Prevention Code*. Terms not defined in the EPCOT Codes shall have the meanings stated in *Merriam-Webster's Tenth New Collegiate Dictionary*, as revised.

SECTION 202 DEFINITIONS

ACCESSIBLE. Having access to, but which first may require the removal of a panel, door or similar covering of the item described. (See "Readily accessible.")

ADMINISTRATIVE AUTHORITY. The individual, official, board, department or agency established and authorized by a state, county, city or political subdivision created by law to administer and enforce the provisions of this Code as adopted or amended.

AIR CONDITIONING. The treatment of air so as to control simultaneously its temperature, humidity, cleanness, and distribution to meet the requirements of a conditioned space.

AIR MIXER. That portion of an injection-type Bunsen burner into which the primary air is introduced.

AIR SHUTTER. An adjustable device for varying the size of the primary air inlet.

AND/OR. In a choice of two code provisions, signifies that use of both provisions will satisfy the code requirement and use of either provision is acceptable also.

APPLIANCE, AUTOMATICALLY CONTROLLED. Appliances equipped with an automatic burner ignition and safety shutoff device and other automatic devices that accomplish complete turn-on and shut off of the gas to the main burner, and graduate the gas supply to the burner, but do not affect complete shut off of the gas.

APPLIANCE EQUIPMENT. Any device that utilizes gas as a fuel or raw material to produce light, heat, power, refrigeration or air conditioning, or to generate a chemical atmosphere.

APPLIANCE FLUE. The flue passages within the appliance.

APPROVED. Approved by the Chief Gas Inspector or the administrative authority.

AUTOMATIC GAS SHUTOFF DEVICE. A device constructed so that the attainment of a water temperature in a hot water supply system in excess of some predetermined limit acts in such a way as to cause the gas supply to the system to be shut off.

AUTOMATIC GAS SHUTOFF VALVE. A valve used in conjunction with an automatic gas shutoff device to shut off the gas supply to a gas-fired, water-heating system. It may be constructed integrally with the shutoff device or be a separate assembly.

AUTOMATIC IGNITION. Means that provide for the ignition of gas at the burner when the gas burner valve controlling the gas to that burner is turned on, and that affect re-ignition if the flames on the burner have been extinguished by means other than closing the gas burner valve.

AUTOMATIC PILOT. See "Safety shutoff device."

BAFFLE. An object placed in an appliance to change the direction of or retard the flow of air, air-gas mixtures or flue gases.

BATHROOM. A room containing a bathtub or shower for use by a person to bathe or cleanse one's self, located in or adjacent to a residence, apartment, hotel, motel or similar-type building.

BOILER. A self-contained, gas-burning appliance for supplying hot water or low-pressure steam, primarily intended for domestic and commercial space-heating applications.

BRANCH LINE. Gas piping that conveys gas from a supply line to the appliance.

BRAZING. A metal joining process wherein coalescence is produced by the use of a nonferrous filler metal having a melting point higher than 1,000°F, but lower than that of the base metal being joined. The filler material is distributed between the closely fitted surfaces of the joint by capillary attraction.

BRITISH THERMAL UNIT (BTU). The quantity of heat required to raise the temperature of 1 pound of water 1°F.

BROILER UNIT. A separate appliance, a general term including broilers, salamanders, barbecues, and other devices cooking primarily by radiated heat, excepting toasters.

BUILDING PIPING. The gas piping from the point where it enters the building or foundation up to and including the outlets. This is applicable where the gas meter is located some distance from the building or the liquefied petroleum gas (LP gas) is delivered without a meter.

The gas piping from the gas meter to and including the outlets. This is applicable where the gas meter is located in or immediately adjacent to the building. (Also see "Consumers' gas piping.")

DEFINITIONS

BURNER. A device for the final conveyance of gas, or a mixture of gas and air, to the combustion zone.

Atmospheric-injection type. A burner in which the air at atmospheric pressure is injected into the burner by a jet of gas.

Injection-type (bunsen). A burner employing the energy of a jet of gas to inject air for combustion into the burner and mix it with the gas.

Luminous or yellow flame. A burner in which secondary air only is depended on for the combustion of the gas.

Power. A burner in which either gas or air, or both, are supplied at pressures exceeding, for gas, the line pressure, and for air, atmospheric pressure, this added pressure being applied at the burner.

Premixing. A power burner in which all or nearly all of the air for combustion is mixed with the gas as primary air.

Pressure. A burner that is supplied with an air-gas mixture under pressure (usually from $\frac{1}{2}$ inch to 14 inches of water and occasionally higher).

CENTRAL HEATING GAS APPLIANCE. A vented gas-fired appliance comprised of the following classes as defined herein: boiler, central furnace, floor furnace or vented wall furnace.

CHIEF GAS INSPECTOR. See “Administrative authority.”

CHIMNEYS.

Factory-built chimneys. Chimneys that are factory made, listed by a nationally recognized testing agency, for venting gas appliances, gas incinerators, and solid or liquid fuel-burning appliances.

Masonry. Field-constructed chimneys built in accordance with nationally recognized codes or standards.

Metal. Chimneys made of metal of 0.135-inch minimum, galvanized or painted, unless suitably corrosion resistant, properly welded or riveted, and built in accordance with nationally recognized codes or standards.

CLOSED WATER PIPING SYSTEM. A system of water piping where a check valve or other device prevents the free return of water or steam to the water main.

CLOTHES DRYER. A device used to dry wet laundry by means of heat derived from the combustion of fuel gases. Dryer classifications are as follows:

Type 1. Factory-built package, multiple produced. Primarily used in a family living environment. May or may not be coin operated for public use. Usually the smallest unit physically and in function output.

Type 2. Factory-built package, multiple produced. Used in business with direct intercourse of the function with the public. May or may not be operated by the public or a hired attendant. May or may not be coin operated. Not designed for use in an individual family living environment. May be small, medium or large in relative size.

COMBUSTIBLE CONSTRUCTION. A wall or surface constructed of wood, composition, or of wooden studding, and lath and plaster.

COMBUSTION. The rapid oxidation of fuel gases accompanied by the production of heat, or heat and light.

COMBUSTION CHAMBER. The portion of an appliance within which combustion occurs.

COMBUSTION PRODUCTS. Constituents resulting from the combustion of a fuel with the oxygen of the air, including inert gases, but excluding excess air.

CONCEALED GAS PIPING. Piping that, when in place in the finished building, would require removal of permanent construction to gain access to the piping.

CONDENSATE. The liquid that separates from a gas (including flue gas) due to a reduction in temperature. Also called condensation.

CONDENSING FURNACE. A furnace or boiler that condenses part of the water vapor generated by the burning of hydrogen in fuels and in which the fraction of the total latent heat remaining in the flue gases after condensation is less than unity.

CONFINED SPACE. A space whose volume is less than 50 cubic feet per 1,000 Btu per hour (Btu/h) of the aggregate input rating of all appliances installed in that space.

CONSUMERS' GAS PIPING. All gas piping and fittings extending from the point of delivery to the outlets, exclusive of piping, meters, regulators, valves, fittings, etc., owned by the gas utility company, and exclusive of tanks, piping, meters, regulators, valves, fittings, etc., installed for the purpose of storing, delivering or regulating LP gas at pressures in excess of the pressure normally delivered to appliances. This includes yard line and/or building piping.

CONTROL. A device designed to regulate the gas, air, water or electrical supply to a gas appliance. It may be manual or automatic.

CONVERSION BURNER. A burner designed to supply gaseous fuel to an appliance originally designed to utilize another fuel.

COUNTER APPLIANCES, GAS. Appliances, such as gas-operated coffee brewers and coffee urns, and any appurtenant water-heating equipment, food and dish warmers, hot plates, griddles, waffle bakers and other appliances designed for installation on or in a counter.

CUBIC FOOT. The amount of gas that occupies 1 cubic foot when at a temperature of 60°F, saturated with water vapor and under a pressure equivalent to that of 30 inches of mercury.

DECORATIVE APPLIANCE, VENTED. A vented appliance whose only function lies in the esthetic effect of the flames.

DECORATIVE APPLIANCES FOR INSTALLATION IN A VENTED FIREPLACE. A self-contained, free-standing, fuel-gas-burning appliance designed for installation only in a vented fireplace and whose primary function lies in the esthetic effect of the flame.

Coal basket. An open-flame-type appliance consisting of a metal basket filled with simulated coals, which gives the appearance of a coal fire when in operation.

Fireplace insert. Consists of an open-flame radiant-type appliance mounted in a decorative metal panel to cover the

fireplace or mantel opening, and having provisions for venting into the fireplace chimney.

Gas log. An open-flame-type appliance consisting of a metal frame or base supporting simulated logs.

Radiant appliance. An open-front appliance designed primarily to convert the energy in fuel gas to radiant heat by means of refractory radiants or similar radiating materials.

DEMAND. The maximum amount of gas required per unit of time, usually expressed in cubic feet per hour or Btu/h, required for the operation of the appliance supplied.

DILUTION AIR. Air that enters a draft hood or draft regulator and mixes with flue gases.

DIRECT GAS-FIRED MAKEUP AIR HEATER. A heater used to temper makeup air in which all the heat and products of combustion generated by the gas burner are released into the airstream being heated.

DIRECT-VENT APPLIANCES. Appliances that are so constructed and installed that all air for combustion is derived from, and all flue gases are discharged to, the outside atmosphere.

DIVERSITY FACTOR. Ratio of the maximum probable demand to the maximum possible demand.

DRAFT HOOD. Nonadjustable device built into an appliance, or made a part of the vent connector from an appliance that is designed to:

- (a) Provide for the ready escape of the products of combustion in the event of no draft, backdraft or stoppage beyond the draft hood;
- (b) Prevent a backdraft from entering the appliance; and
- (c) Neutralize the effect of the stack action of the vent upon the operation of the appliance.

DRAFT REGULATOR. A device which functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value.

DRIP. The container placed at a low point in a system of piping to collect condensate and from which the condensate may be removed.

DRY GAS. A gas having a moisture and hydrocarbon dew point below any normal temperature to which the gas piping is exposed.

DUCT FURNACE. A warm-air furnace normally installed in an air distribution duct or air-conditioning system to supply warm air for heating. This definition shall apply only to an appliance that depends on air circulation on a blower that is not furnished as part of the furnace.

EXCESS AIR. Air that passes through the combustion chamber and the appliance flues in excess of that which is theoretically required for complete combustion.

EXPOSED PIPING. Gas piping that will be in view in the finished structure.

FIRING VALVE. A valve of the plug-and-barrel type designed for use with gas, and equipped with a lever handle

for manual operation and a dial to indicate the percentage of opening.

FLAME SAFEGUARD. A device that will automatically shut off the gas supply to a main burner or group of burners when the means of ignition of such burners becomes inoperative, and when flame failure occurs on the burner or group of burners.

FLAME.

Bunsen. The flame produced by premixing some of the air required for combustion with the gas before it reaches the burner ports or point of ignition.

Yellow, luminous or nonbunsen. The flame produced by burning gas without premixing any of the air with the gas.

FLOOR FURNACE. A completely self-contained unit suspended from the floor of the space being heated, taking air for combustion from outside this space, and with means for observing flames and lighting the appliance from such space.

Fan-type. A floor furnace equipped with a fan that provides the primary means for circulating air.

Gravity-type. A floor furnace depending primarily upon the circulation of air by gravity. This classification also shall include floor furnaces equipped with booster-type fans that do not materially restrict the free circulation of air by gravity flow when such fans are not in operation.

FLUE COLLAR. That portion of an appliance designed for the attachment of the draft hood or vent connector.

FLUE EXHAUSTER. A device installed in and made a part of the vent that will provide a positive induced draft.

FLUE GASES. Products of combustion plus excess air in appliance flues or heat exchangers (before the draft hood or draft regulator).

FURNACE, CENTRAL. A self-contained appliance for heating air by transfer of heat of combustion through metal to the air, and designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.

Downflow forced-air-type. A furnace designed with airflow discharge vertically downward at or near the bottom of the furnace.

Forced-air-type. A central furnace equipped with a fan or blower that provides the primary means for the circulation of air.

Gravity-type. A central furnace primarily depending on circulation of air by gravity.

Gravity-type with integral fan. A central furnace equipped with a fan or blower as an integral part of its construction and operable on gravity systems only. The fan or blower is to be used only to overcome the internal furnace resistance to airflow.

Horizontal forced-air-type. A furnace with airflow through the appliance essentially in a horizontal path.

Upflow forced-air-type. A furnace designed with airflow discharge vertically upward at or near the top of the furnace.

DEFINITIONS

GAS CONVENIENCE OUTLET. A permanently mounted, manually operated device that provides the means for connecting an appliance to, and disconnecting an appliance from, the gas supply piping. The device includes an integral, manually operated gas valve with a non-displaceable valve member and is designed so that disconnection can be accomplished only when the manually operated gas valve is in the closed position.

GAS HOSE. A gas conduit that depends on tightness for joint packing, or on any wall structure other than that formed by a continuous one-piece metal tubing member.

GAS UTILITY COMPANY. The organization operating the gas distribution system, or supplying the gas fuel that is being used.

GAS VENTS.

Single-wall metal. Vents constructed of sheet copper of not less than 0.024-inch or 0.040-inch minimum galvanized steel or other approved noncombustible, corrosion-resistant material.

Type B. Factory-made gas vents listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn only gas.

Type BW. Factory-made gas vents listed by a nationally recognized testing agency for venting listed or approved gas-fired vented wall furnaces.

Type L. Factory-made gas vents listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn gas or oil.

GRAVITY. See “Specific gravity.”

HEATING VALUE, TOTAL. The number of Btus produced by the combustion, at a constant pressure, of 1 cubic foot of gas when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all necessary corrections have been applied.

HOTEL AND RESTAURANT RANGE. A gas appliance of the floor type providing for top cooking, roasting, baking or broiling, or any combination of top cooking with any of these other functions and not designed specifically for domestic use.

HOUSE PIPING. See “Building piping.”

IGNITION PILOT. A pilot that operates during the lighting cycle and discontinues during main burner operation.

INCINERATOR, DOMESTIC GAS-FIRED. A domestic appliance used to reduce combustible refuse material to ashes, and that is manufactured, sold and installed as a complete unit.

INFRARED RADIANT HEATER. A heater that directs a substantial amount of its energy output in the form of infrared radiant energy into the area to be heated. Such heaters may be of either the vented or unvented type.

INTERMITTENT PILOT. A pilot that operates during the ignition cycle and continues during main burner operation, but is shut off at other times.

JOINT, PLASTIC ADHESIVE. A joint made in thermoset plastic piping by the use of an adhesive substance that forms a continuous bond between the mating surfaces without dissolving either one of them.

JOINT, PLASTIC HEAT-FUSION. A joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the materials when the parts are pressed together.

JOINT, PLASTIC SOLVENT-CEMENT. A joint made in thermoplastic piping by the use of a solvent or solvent cement that forms a continuous bond between the mating surfaces.

LABELED. Devices, equipment or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of these labeled items and by whose label the manufacturer attests to compliance with applicable nationally recognized standards.

LIMIT CONTROL. A device responsive to changes in pressure or temperature, or level, for turning on, shutting off or throttling the gas supply to an appliance.

LISTED. Equipment or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards, or has been tested and found suitable for use in a specific manner. The means for identifying the listed equipment may vary for each testing laboratory, inspection agency or other organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled.

LUBRICATED PLUG-TYPE VALVE. A valve of the plug-and-barrel type provided with means for maintaining a lubricant between the bearing surfaces.

MAIN BURNER. A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the combustion zone, and on which combustion takes place to accomplish the function for which the appliance is designed.

MAIN BURNER CONTROL VALVE. A valve that controls the gas supply to the main burner manifold.

MANUAL SHUTOFF VALVE. A valve (or cock) of the plug-and-barrel type designed for use with gas; operated manually to control or shut off the supply of gas.

MEASURED GAS. Gas that has passed through and the volume of which has been measured by a meter, or gas that has been otherwise measured, such as by weight or volume.

MEDIUM PRESSURE (MP) REGULATOR, 2 PSI. A line pressure regulator that reduces the 2-pound-per-square-inch consumers’ gas piping pressure to the appliance regulator or to the appliance utilization pressure.

METER. The instrument installed to measure the volume of gas delivered through it.

MOBILE HOME. A vehicular, portable structure built on a chassis and designed to be used without a permanent foundation as a dwelling when connected to indicated utilities.

MODULATING. Modulating or throttling is the action of a control from its maximum to minimum position in either predetermined steps or increments of movement as caused by its actuating medium.

ORIFICE. The opening in a cap, spud or other device whereby the flow of gas is limited, and through which the gas is discharged to the burner.

ORIFICE CAP (HOOD). A movable fitting having an orifice that permits the adjustment of the flow of gas by the changing of its position with respect to a fixed needle or other device.

ORIFICE SPUD. A removable plug or cap containing an orifice and that permits the adjustment of the flow of gas either by substitution of a spud with a different sized orifice or by the motion of a needle with respect to it.

OUTLET. A threaded connection or bolted flange in a pipe system to which a gas-burning appliance is or may be attached. Outlets must be located in the room or space where the appliance is or may be installed.

OXYGEN-DEPLETION SAFETY SHUTOFF SYSTEM (ODS). A system designed to act to shut off the gas supply to the main and pilot burners if the oxygen in the surrounding atmosphere is reduced below a predetermined level.

PILOT. A small flame that is utilized to ignite the gas at the main burner or burners.

PIPING. Where the word piping is used in this Code, it refers to either pipe or tubing, or both.

Pipe. A rigid conduit of iron, steel, copper, brass or plastic.

Tubing. Semi-rigid conduit of copper, aluminum, plastic or steel.

PLASTIC, THERMOPLASTIC. A plastic that is capable of being repeatedly softened by the increase of temperature and hardened by the decrease of temperature.

PLASTIC, THERMOSETTING. A plastic that is capable of being changed into a substantially infusible or insoluble product when cured under the application of heat or chemical means.

PLENUM. Air compartment or chamber to which one or more ducts are connected and form part of an air distribution system.

POINT OF DELIVERY. The initial junction of the consumers' piping with either the gas utility company piping extending from the gas main and/or the regulator that reduces the pressure of the undiluted LP gas to the pressure normally delivered to appliances.

PRIMARY AIR. The air introduced into a burner and mixing with the gas before it reaches the port.

PURGE. To free a gas conduit of air, gas, or a mixture of gas and air.

QUICK-DISCONNECT DEVICE. A hand-operated device that provides a means for connecting and disconnecting an appliance or an appliance connector to a gas supply, and that is equipped with an automatic means to shut off the gas supply when the device is disconnected.

READILY ACCESSIBLE. Having direct access without needing to remove any panel, door or similar covering of the item described, and without requiring the use of portable ladders, chairs, etc.

REGULATOR. A device for controlling and maintaining a uniform gas supply pressure, either pounds to inches water column (MP regulator) or inches to inches water column (appliance regulator).

RELIEF OPENING. The opening provided in a draft hood to permit the ready escape to the atmosphere of the flue products from the draft hood in the event of no draft, backdraft or stoppage beyond the draft hood, and to permit air into the draft hood in the event of a strong chimney updraft.

RELIEF VALVE (DEVICE). A safety valve designed to forestall the development of a dangerous condition by relieving either pressure, temperature or vacuum in the hot water supply system.

RELIEF VALVE, PRESSURE. An automatic valve that opens and closes a relief vent, depending on whether the pressure is above or below a predetermined value.

RELIEF VALVE, TEMPERATURE.

Manual-reset-type. A valve that automatically opens a relief vent at a predetermined temperature and must be manually returned to the closed position.

Reseating or self-closing-type. An automatic valve which opens and closes a relief vent, depending on whether the temperature is above or below a predetermined value.

RELIEF VALVE, VACUUM. An automatic valve that opens and closes a vent for relieving a vacuum within the hot water supply system depending on whether the vacuum is above or below a predetermined value.

RETURN AIR SYSTEM. An assembly of connected ducts, plenums, fittings, registers, and grilles, through which air from the spaces to be heated or cooled is conducted back to the supply unit. (See also "Supply air system.")

ROOM HEATER. A self-contained, gas-burning appliance installed in and for heating rooms. This definition shall not include unit heaters, central heating gas appliances, garage heaters or vented wall furnaces.

SAFETY SHUTOFF DEVICE. A device that will shut off the gas supply to the controlled burners in the event the source of ignition fails to ignite the gas at the burners. This device may interrupt the flow of gas to the main burners only, or to the pilot and the burners under its supervision.

SECONDARY AIR. The air externally supplied to the flame at the point of combustion.

SERVICE PIPE. The pipe that brings the gas from the gas main to the point of delivery.

DEFINITIONS

SPECIFIC GRAVITY. As applied to gas, specific gravity is the ratio of the weight of a given volume to that of the same volume of air, both measured under the same condition.

STOP COCK. See “Manual shutoff valve.”

SUPPLY AIR SYSTEM. An assembly of connected ducts, plenums, fittings, registers and grilles through which air, heated or cooled, is conducted from the supply unit to the space or spaces to be heated or cooled. (See also “Return air system.”)

THERMOSTAT. An automatic device actuated by temperature changes, designed to control the gas supply to a burner, in order to maintain temperatures between predetermined limits.

TRANSITION FITTINGS, PLASTIC TO STEEL. An adapter for joining plastic pipe to steel pipe. The purpose of this fitting is to provide a permanent, pressure-tight connection between two materials that cannot be directly joined to one another.

UNCONFINED SPACE. A space whose volume is not less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all appliances installed in that space. Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

UNIT HEATER. A self-contained, gas-burning appliance of the fan type, designed for the delivery of warm air directly into the space in which the appliance is located.

UNLISTED BOILER. A boiler not listed by a nationally recognized testing agency or a boiler not originally furnished by the manufacturer with integrally assembled gas burner and automatic control devices.

UNMEASURED GAS. Gas that has not passed through and the volume of which has not been registered by a meter, or gas that has not otherwise been measured, such as by liquid volume or weight.

UNUSUALLY TIGHT CONSTRUCTION. Construction meeting the following requirements:

- (a) Walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder with a rating of 1 perm or less with openings gasketed or sealed.
- (b) Storm windows or weather stripping on openable windows and doors.
- (c) Caulking or sealants applied to areas such as joints around window and door frames; between sole plates and floors; between wall-ceiling joints; between wall panels; at penetrations for plumbing, electrical and gas lines; and at other openings.

UNVENTED ROOM HEATER. An unvented heating appliance designed for stationary installation and utilized to provide comfort heating. Such appliances provide radiant or convection heat by gravity or fan circulation directly from the heater and do not utilize ducts.

VALVE. See “Manual shutoff valve.”

VENT. A passageway for conveying flue gases from fuel-burning appliances, or their vent connectors, to the outside atmosphere.

VENT CONNECTOR. That portion of the vent system that connects the gas appliance to the gas vent or chimney.

VENT DAMPER DEVICE, AUTOMATIC. A device intended for installation in the venting system, in the outlet of or downstream of the appliance draft hood, of an individual, automatically operated, fuel-gas-burning appliance, and that is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby or shut-down condition.

Electrically operated. An operation that employs electrical energy to control the device.

Mechanically actuated. An operation dependent on the direct application or transmission of mechanical energy without employing any type of energy conversion.

Thermally actuated. An operation exclusively dependent upon the direct conversion of the thermal energy of the vent gases into mechanical energy.

VENT GASES. Products of combustion from gas appliances plus excess air and dilution air in the vent connector, gas vent or chimney above the draft hood or draft regulator.

VENT SYSTEM. A continuous open passageway from the flue collar or draft hood of a gas-burning appliance to the outside atmosphere for the purpose of removing flue or vent gases. A venting system is usually composed of a vent or a chimney, and vent connector, if used, assembled to form the open passageway.

Mechanical draft venting system. A venting system designed to remove flue or vent gases by mechanical means, which may consist of an induced draft portion under nonpositive static pressure and/or a forced draft portion under positive static pressure.

Forced draft venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static vent pressure.

Induced draft venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under nonpositive static vent pressure.

Power venting system. See “Forced draft venting system.”

Natural draft venting system. A venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.

VENTED APPLIANCE CATEGORIES.

Category I. An appliance that operates with a nonpositive vent static pressure and a vent gas temperature above a value, both measured as specified in the appropriate nationally recognized appliance standard. They can be either draft-hood-equipped or fan-assisted combustion system appliances.

Category II. An appliance that operates with a nonpositive vent static pressure and a vent gas temperature below a value, both measured as specified in the appropriate nationally recognized appliance standard.

Category III. An appliance that operates with a positive vent static pressure and a vent gas temperature above a value, both measured as specified in the appropriate nationally recognized appliance standard.

Category IV. An appliance that operates with a positive vent static pressure and a vent gas temperature below a value, both measured as specified in the appropriate nationally recognized appliance standard.

VENTED ROOM HEATER. A vented self-contained, free-standing, nonrecessed, gas-burning appliance for furnishing warm air to the space in which it is installed, directly from the heater without duct connections.

VENTED WALL FURNACE (RECESSED HEATER). A self-contained vented appliance complete with grilles or equivalent, designed for incorporation in or permanent attachment to the structure of a building, mobile home or travel trailer, and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing. Such appliances shall not be provided with duct extensions beyond the vertical and horizontal limits of the casing proper, except that boots not to exceed 10 inches beyond the horizontal limits of the casing for extension through walls of normal thickness may be permitted. Where such boots are provided, they shall be supplied by the manufacturer as an integral part of the appliance and tested as such. This definition shall exclude floor furnaces, unit heaters and central furnaces, as herein defined.

WALL HEATER, UNVENTED CLOSED FRONT. An unvented room heater of the circulator type, having a closed front, for insertion in or attachment to a wall or partition. It incorporates no concealed venting arrangements in its construction and discharges all products of combustion through the front into the room being heated.

WALL HEATER, UNVENTED-TYPE. A room heater of the type designed for insertion in or attachment to a wall or partition. It incorporates no concealed venting arrangements in its construction and discharges all products of combustion through the front into the room being heated.

WATER HEATERS.

Automatic instantaneous. The type which heats the water as it is drawn.

Automatic storage. The type which combines a water-heating element and water storage tank; gas to the main burner being controlled by a thermostat.

Circulating or tank. Manually controlled type usually connected to the ordinary hot water tank.

YARD LINE. The section of consumers' piping and fittings extending from the point of delivery to the house piping.

CHAPTER 3

GAS PIPING INSTALLATIONS

SECTION 301 GENERAL

301.1 Scope. This Chapter provides the fundamental requirements for the installation of consumers' gas piping. The installing agency shall be responsible for complying with these requirements.

SECTION 302 PIPING PLAN

302.1 Plan requirements. Before proceeding with the installation of a gas piping system, a piping sketch or plan shall be required to show the proposed location of the piping, the developed length of the piping, the location of valves, regulators, devices, and appliances, as well as the size of different branches, and the demand for each of the existing and/or new appliances. Adequate consideration shall be given to future demands and provisions shall be made for added gas services.

When an additional appliance is to be served, the existing piping shall be checked to determine if it has adequate capacity (see Section 305). If inadequate, the existing system shall be enlarged, as required, or separate gas piping of adequate capacity shall be provided.

SECTION 303 METER LOCATION

303.1 Accessible and acceptable location. A meter location, when required, shall be provided for the building or premises to be served. The location shall be such that the meter and connections are accessible in order that the meter may be read or changed. The owner shall furnish a shutoff valve separate from any supplied by the gas utility company on the regulator header so his system can be controlled without interfering with the gas utility company's valves or equipment. Location, space requirements, dimensions and the type of installation shall be acceptable to the gas utility company.

303.2 Pipe identification. Piping from a multiple meter installation shall be plainly marked by the installer so that the piping system supplied by each meter can be readily identified. Exposed piping shall be painted safety yellow in its entirety in compliance with the Occupational Safety and Health Administration (OSHA). Concealed piping shall be permanently marked at every 10-foot length, and where each pipe passes through a wall, or on one side of a change in direction. Buried piping shall be identified by approved marker tape placed 6 inches minimum above piping. All underground plastic piping shall have an electrically conductive wire or other suitable means to provide a positive location. When a wire is used, it shall have an insulating coating.

SECTION 304 INTERCONNECTIONS

304.1 Interconnections prohibited. When two or more meters are installed on the same premises, but supply separate

consumers, the piping systems shall not be interconnected on the outlet side of the meters or service regulators.

SECTION 305 REQUIRED SIZE OF PIPING AND OUTLETS

305.1 General.

305.1.1 Gas conversion. Notwithstanding the provisions of this Section to the contrary, consumers' gas piping sized or installed for one type of gas may be converted to use another type of gas if the Chief Gas Inspector finds, upon inspection and proper test, that such piping will render satisfactory gas service to the consumer, and will not in any way endanger life or property; otherwise, such piping shall be altered or replaced in whole or in part, to comply with the requirements of this Chapter.

305.1.2 Liquefied petroleum gas. Pipe sizing for undiluted liquefied petroleum gas (LP gas) is addressed in Chapter 9.

305.2 Minimum sizes. When the gas supply pressure is $\frac{1}{2}$ pound per square inch gauge (psig) or less and the gas meter is located within 3 feet of the building exterior, all building piping from the meter outlet downstream, including the pipe outlets, shall be a minimum of $\frac{1}{2}$ -inch diameter. When the gas meter is located a distance in excess of 3 feet from the building exterior, yard line piping shall be a minimum of 1-inch diameter. Larger sizes may be required based on demand. (See Subsection 305.4.)

305.3 Required gas supply.

305.3.1 Maximum hourly rating. The hourly volume of gas required at each outlet shall be taken as not less than the maximum hourly rating, as specified by the manufacturer of the appliance, to be connected to each such outlet.

305.3.2 Cubic feet per hour required. To obtain the cubic feet per hour of gas required, divide the maximum Btu input of an appliance by the average Btu heating value per cubic foot of gas being supplied.

305.3.3 Estimating typical appliances. Where the Btu ratings of the gas appliances to be installed have not been specified, Table 305.3.3 may be used as a reference when sizing pipe to estimate the approximate requirements in Btu per hour (Btu/h) of typical appliances.

305.4 Required gas piping size. When the gas pressure is $\frac{1}{2}$ psi or less, use the following method to determine the sizes of consumers' gas piping from the point of delivery. For Schedule 40 gas pipe, use Table 305.4A; for tubing, use Table 305.4B; for plastic pipe, use Table 305.4C, 305.4D or 305.4E; for corrugated stainless steel tubing (CSST), use Table 305.4F.

- Measure the length of piping from the point of delivery to the most remote outlet in the building.
- In the first column in the table, select the horizontal line showing that distance, or next longer distance if the table does not give the exact length.

GAS PIPING INSTALLATIONS

- (c) Use this horizontal line to locate all gas demand figures for this particular system of gas piping.
- (d) Starting at the most remote outlet, find in the horizontal line just selected, the gas demand for that outlet. If the exact figure of gas demand is not shown, choose the next larger figure to the right on the same line.
- (e) Above this demand figure in the top horizontal line in the table will be found the nominal size of pipe required.
- (f) For each succeeding section of pipe, determine the total gas demand supplied by such section and then proceed in the manner outlined in Paragraphs (a) through (e) to determine the size of each section of pipe.

TABLE 305.3.3
APPROXIMATE MAXIMUM DEMAND
OF TYPICAL GAS APPLIANCES

APPLIANCE	DEMAND (Btu/h)
Domestic	
Clothes dryer	35,000
Gas light	2,000
Incinerator	35,000
Oven, built-in	25,000
Range, free-standing	65,000
Top burner unit, built-in	40,000
Refrigerator	3,000
Residential	
Barbecue grill	50,000
Fireplace log lighter	25,000
Restaurant	
Range—4 Top burners, 2 ovens	150,000
Range—6 Top burners, 2 – 4 ovens	240,000
Steam boiler—per horsepower	50,000
Storage water heater	
Up to and including a 30-gallon tank	30,000
More than a 30-gallon tank, including a 50-gallon tank	55,000

305.5 Example. See Appendix B for the example problem using Tables 305.3.3 and 305.4A.

305.6 Sizing requirements for special conditions.

305.6.1 Approval required. For conditions other than those set forth in Subsection 305.4 and Appendix B, or those covered by Tables 305.4A and 305.4B—such as longer runs or larger sizes of piping, greater gas demands, the application of a diversity factor when calculating for multiple-family dwellings, pressures greater than 15 inches of water column or less than 4 inches of water column pressure, or specific gravity other than 0.55 to 0.75—the size of the piping required shall be calculated in a manner approved by the Chief Gas Inspector.

305.6.2 Larger size pipes. Where pipe sizes larger than those set forth in this Section are specified by pipe sizing requirements established by the Chief Gas Inspector, these larger sizes shall be used.

305.6.3 Alternative sizing methods. In lieu of the method specified in this Section for determining building piping

size, piping sizes may be determined by the use of accurate gas flow, computers or pressure drop charts, all of which must be approved by the Chief Gas Inspector, so long as the maximum pressure drop from the point of delivery to any appliance does not fall below the minimum pressure required for proper equipment operations.

305.7 Diversity factor. A diversity factor shall be used to determine the correct size of consumers' gas piping in multiple-family dwellings. It is dependent upon the number and kinds of gas appliances installed. When two or more family dwelling units are supplied by a common gas supply line, the Btu/h demand for the common gas line shall not be less than the values shown in Table 305.7.

TABLE 305.4A
GAS PIPE
MAXIMUM CAPACITY
OF PIPE IN CUBIC FEET OF GAS PER HOUR BASED
ON A PRESSURE DROP OF 1/2-INCH WATER COLUMN
AND 0.6 SPECIFIC GRAVITY GAS, AND SCHEDULE 40 PIPE

LENGTH (feet)	PIPE SIZE/INSIDE DIAMETER (inches)									
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
10	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	6.065
10	175	360	680	1,400	2,100	3,950	6,300	11,000	23,000	69,600
20	120	250	465	950	1,460	2,750	4,350	7,700	15,800	49,300
30	97	200	375	770	1,180	2,200	3,520	6,250	12,800	40,200
40	82	170	320	660	990	1,900	3,000	5,300	10,900	34,800
50	73	151	285	580	900	1,680	2,650	4,750	9,700	31,200
60	66	138	260	530	810	1,520	2,400	4,300	8,800	28,400
70	61	125	240	490	750	1,400	2,250	3,900	8,100	26,300
80	57	118	220	460	690	1,300	2,050	3,700	7,500	24,600
90	53	110	205	430	650	1,220	1,950	3,450	7,200	23,200
100	50	103	195	400	620	1,150	1,850	3,250	6,700	22,000
125	44	93	175	360	550	1,020	1,650	2,950	6,000	19,700
150	40	84	160	325	500	950	1,500	2,650	5,500	18,000
175	37	77	145	300	460	850	1,370	2,450	5,000	16,000
200	35	72	135	280	430	800	1,280	2,280	4,600	15,600
225	25	57	115	253	392	793	1,230	2,200	4,475	14,688
250	24	54	109	240	372	752	1,185	2,175	4,350	13,934
275	23	52	104	229	355	717	1,140	2,050	4,225	13,286
300	22	50	100	219	340	686	1,090	1,975	4,100	12,720
350	20	46	92	203	314	635	1,043	1,897	3,969	11,777
400	19	43	86	190	294	594	975	1,775	3,712	11,016
450	18	41	81	179	277	560	920	1,673	3,500	10,386
500	17	38	77	170	263	532	872	1,588	3,320	9,853
550	16	37	74	162	251	507	832	1,514	3,166	9,394
600	15	35	71	155	240	485	796	1,449	3,031	8,994
700	14	33	65	143	222	449	737	1,342	2,806	8,327
800	13	30	61	134	208	420	690	1,255	2,625	7,789
900	13	29	58	126	196	396	650	1,183	2,475	7,344
1,000	12	27	55	120	186	376	617	1,123	2,348	6,967

TABLE 305.4B
GAS TUBING
MAXIMUM CAPACITY OF TUBING IN CUBIC
FEET OF GAS PER HOUR BASED ON A PRESSURE DROP
OF 1/2-INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY GAS

Length (feet)	TUBING SIZE/OUTSIDE DIAMETER (inches)						
	3/8	1/2	5/8	3/4	7/8	1 1/8	1 3/8
10	28	66	126	218	341	705	1,251
20	19	44	85	146	229	473	840
30	15	35	67	116	181	375	665
40	13	30	57	98	154	318	564
50	11	26	50	86	135	280	496
60	10	24	45	78	122	252	447
70	9	22	41	71	111	230	409
80	9	20	38	66	103	213	379
90	8	19	36	62	96	199	354
100	8	18	34	58	91	188	333
120	7	16	30	52	82	169	300
140	6	15	28	48	75	155	274
160	6	13	26	44	69	143	254
180	5	13	24	41	65	134	237
200	5	12	23	39	61	126	224
220	5	11	21	37	58	119	212
240	5	11	20	35	55	113	201
260	4	10	19	34	52	108	192
280	4	10	19	32	50	104	184
300	4	9	18	31	48	100	177
320	4	9	17	30	47	96	171
340	4	9	17	29	45	93	165
360	4	8	16	28	43	90	159
380	4	8	16	27	42	87	155
400	3	8	15	26	41	85	150

TABLE 305.4C
PLASTIC PIPE TUBING
MAXIMUM CAPACITY OF PLASTIC PIPE IN CUBIC FEET
OF GAS PER HOUR BASED ON A PRESSURE DROP
OF 1/2-INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY GAS

LENGTH (feet)	PIPE SIZE/OUTSIDE DIAMETER (inches)			
	3/8	1/2	5/8	7/8
	0.062 wall	0.062 wall	0.062 wall	0.062 wall
10	16	47	103	310
20	11	32	69	208
30	8	25	55	165
40	7	21	46	140
50	6	19	41	123
60	6	17	37	111
70	5	15	34	101
80	5	14	31	94
90	4	13	29	88
100	4	13	27	83
125	4	11	24	73
150	3	10	22	65
175	3	9	20	60
200	3	8	18	55
225	3	8	17	52
250	2	7	16	49

Note: Limited to applications included in Subsections 306.3, 306.4 and 309.14. Capacities based upon the Mueller formula for low-pressure installations of smooth tubing less than 1 psi.

TABLE 305.4D
PLASTIC PIPE TUBING
MAXIMUM CAPACITY OF PLASTIC PIPE
IN CUBIC FEET OF GAS PER HOUR BASED ON A PRESSURE
DROP OF 1/2-INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY
GAS, AND A WALL THICKNESS AS SPECIFIED IN THE TABLE

LENGTH (feet)	PIPE SIZE/OUTSIDE DIAMETER (inches)			
	5/8	7/8	1 1/8	1 1/8
	0.090 wall	0.090 wall	0.090 wall	0.099 wall
10	73	242	536	581
20	49	163	360	390
30	39	129	285	309
40	33	109	242	262
50	29	96	213	230
60	26	87	191	207
70	24	79	175	190
80	22	73	162	176
90	21	69	152	164
100	19	64	143	154
125	17	57	126	136
150	15	51	113	122
175	14	47	103	112
200	13	43	96	104
225	12	40	90	97
250	11	38	84	91
275	11	36	80	86
300	10	34	76	82
325	10	33	72	78
350	9	31	69	75
375	9	30	67	72
400	9	29	64	70
500	8	25	57	61
600	7	23	51	55
700	6	21	47	50
800	6	20	43	47
900	5	18	40	44
1000	5	17	38	41

Note: Limited to applications included in Subsections 306.3, 306.4 and 309.14. Capacities based upon the Mueller formula for low-pressure installations of smooth tubing less than 1 psi.

GAS PIPING INSTALLATIONS

TABLE 305.4E
PLASTIC GAS PIPE
MAXIMUM CAPACITY OF PLASTIC PIPE IN CUBIC FEET OF GAS PER HOUR BASED ON A PRESSURE DROP
OF 1/2-INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY GAS, AND A WALL THICKNESS AS SPECIFIED IN THE TABLE

LENGTH (feet)	PIPE SIZE/OUTSIDE DIAMETER (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
	0.090 wall	0.095 wall	0.119 wall	0.166 wall	0.173 wall	0.216 wall
10	212	437	807	1,428	2,192	4,079
20	143	293	542	959	1,471	2,705
30	113	232	429	759	1,165	2,142
40	96	197	364	644	988	1,816
50	84	173	320	566	869	1,597
60	76	156	288	510	782	1,438
70	69	143	264	467	716	1,316
80	64	132	244	432	663	1,219
90	60	124	228	404	620	1,139
100	57	116	215	380	583	1,072
125	50	102	189	344	513	943
150	45	92	170	301	462	849
175	41	84	156	275	423	777
200	38	78	144	255	391	720
225	35	73	135	238	366	672
250	33	69	127	224	344	633
275	32	65	120	212	326	599
300	30	62	114	202	310	570
325	29	59	109	193	296	544
350	28	57	104	185	284	522
375	26	54	100	178	273	501
400	25	52	97	171	263	483
500	22	46	85	151	231	425
600	20	42	77	136	208	383
700	18	38	70	124	190	350
800	17	35	65	115	176	324
900	16	33	61	107	165	303
1,000	15	31	57	101	155	285

Note: Capacities based upon the Mueller formula for low-pressure installations of smooth tubing less than 1 psig.

TABLE 305.4F
CORRUGATED STAINLESS STEEL TUBING
MAXIMUM CAPACITY^a CSST IN CUBIC FEET OF GAS PER HOUR FOR A
GAS PRESSURE OF 1/2 PSIG OR LESS, AND A PRESSURE DROP OF 1/2-INCH WATER COLUMN
AND 0.60-SPECIFIC-GRAVITY GAS

EHD ^b FLOW DESIGNATION	NOMINAL TUBING SIZE (inches)	TUBING LENGTH (feet)																
		5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
13	3/8	46	32	25	22	19	18	15	13	12	11	10	10	9	7	6	5	5
14	3/8	63	44	35	31	27	25	21	19	17	16	15	14	13	10	9	8	7
18	1/2	115	82	66	58	52	47	41	37	34	31	29	28	26	20	18	16	15
19	1/2	134	95	77	67	60	55	47	42	38	36	33	32	30	23	21	19	17
23	3/4	225	161	132	116	104	96	83	75	66	63	60	57	54	42	38	34	32
24	3/4	270	192	157	137	122	112	97	87	80	74	69	65	62	48	44	39	36
30	1	471	330	267	231	206	188	162	144	131	121	113	107	101	78	71	63	57
31	1	546	383	310	269	240	218	188	168	153	141	132	125	118	91	82	74	67

- a. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$ where L is an additional length (feet) of tubing and n is the number of additional fittings and/or bends.
- b. Equivalent hydraulic diameter (EHD)—A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

TABLE 305.7
DEMAND VALUES FOR USE IN DETERMINING GAS PIPING SIZE IN MULTIPLE DWELLING UNITS
BASED ON SIMILAR APPLIANCES BEING INSTALLED IN EACH UNIT

NUMBER OF UNITS	PERCENT OF TOTAL CONNECTED LOAD	
	Ranges only	Ranges and water heaters
2	85	77
4	65	59
6	54	49
8	46	44
10	42	40
15	36	34
20	31	30
30	25	24
40	23	22
50	21	20
60	19.9	19.1
70	18.8	18.0
80	17.7	16.9
90	16.6	15.8
100	15.4	14.7
125	14.6	14.0
150	13.8	13.3
175	13.0	12.6
200	12.3	11.8

Note: When individual space heating appliances are installed in each dwelling unit, add 90 percent of the total heating load connected to the common gas supply line for the hourly heating demand to be added to the demand values given in this table.

SECTION 306

PIPING MATERIALS AND WORKMANSHIP

306.1 Metallic pipe. Metallic gas piping shall be of steel pipe complying with ASME B36.10, ASTM A53 or ASTM A106. Where approved by the Chief Gas Inspector, copper or brass pipe in steel pipe sizes assembled with threaded fittings of the same materials may be used when the gas does not contain more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas (a trace as determined by ASTM D2385 or ASTM D2420). Exposed gas piping in kitchen applications shall be of 316 Grade stainless steel, minimum Schedule 10. Headers and drops shall be full size to the last appliance, with outlets facing down at a minimum height of 40 inches above the finish floor. Gas manifolds shall have a drop for each appliance supplied.

306.2 Metallic tubing. Copper tubing shall be of standard Type K or L complying with ASTM B88 or ASTM B280. Steel tubing shall comply with ASTM A254 or ASTM A539. CSST systems shall be tested, listed, and installed in accordance with ANSI/AGA LC-1. Tin-lined copper tubing shall be used when the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas (a trace as determined by ASTM D2385 or ASTM D2420).

306.3 Plastic piping. Plastic pipe or tubing, and compatible fittings complying with ASTM D2513, or reinforced epoxy resin gas pressure pipe and fittings complying with ASTM D2517, may be used outside, underground only. (See Subsection 309.14 for limitations.)

306.4 Piping joints and fittings.

306.4.1 Metallic.

306.4.1.1 Joints. Pipe joints downstream of the appliance shut-off valve may be threaded, flanged or welded, and nonferrous pipe may also be brazed with materials having a melting point in excess of 1,000°F. Brazing alloys shall not contain phosphorous. The joints listed above may be used for the connection of meters, appliances or other gas appurtenances. All house piping from the meter connection to the appliance shutoff valve shall be welded as follows:

- (a) Tubing joints shall either be made with flared gas tubing fittings or brazed with a material having a melting point in excess of 1,000°F. Brazing alloys shall not contain phosphorous. Metallic ball sleeve compression-type tubing fittings shall not be used for this purpose inside or under buildings, but may be used for other underground connections.

Exception: Indoor connections may be metallic ball sleeve compression type, when they are part of a listed interior piping system.

- (b) Fittings (except stop cocks or valves) shall be of malleable iron or steel when used with steel or wrought iron pipe, and shall be copper or copper-alloy, bronze or brass when used with copper or brass pipe or tubing.

Exception: Interior corrugated stainless steel gas piping systems shall be permitted to be used

with fittings or components of dissimilar materials when part of a listed gas piping system.

- (c) Carbon steel of 2-inch and smaller piping shall be of the socket-welded type, and 2½-inch and larger piping shall be of the butt-welded type.
- (d) Welded steel fittings shall be commercially manufactured. The use of shop- or field-fabricated weld steel fittings shall be subject to the approval of the Chief Gas Inspector.
- (e) Stainless steel of 2-inch and smaller piping and headers shall be either of the butt-welded or socket-welded type; and 2½-inch and larger piping shall be of the butt-welded type.

306.4.2 Plastics. Plastic piping, tubing and fittings shall be joined by either the solvent-cement method, heat-fusion method, or by means of compression couplings or flanges. The joining method used shall be compatible with the materials being joined. The recommendations of the manufacturer shall also be taken into consideration when determining which method is to be used. The following shall be observed when making such joints:

- (a) Plastic piping or tubing shall not be threaded.
- (b) Solvent-cement joints and heat-fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gas-tight joints at least as strong as the piping or tubing being joined.
- (c) Solvent-cement or heat-fusion joints shall not be made between different types of plastic.
- (d) Heat-fusion or mechanical joints shall be used when joining polyethylene (PE) piping, tubing or fittings. Joints made with compression couplings shall be assembled in accordance with the compression coupling manufacturer's recommendation. Only compression couplings designed for use with plastic piping in natural gas service shall be used.
- (e) Flanges or special joints may be used provided they are approved by the manufacturer and utilized in accordance with the manufacturer's recommendations. PE piping and tubing shall not be flared. Polyvinyl chloride (PVC) piping and tubing shall not be flared unless recommended by the manufacturer and only where flared joints are underground.
- (f) When compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the gas utility company. An internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with the end of the piping or tubing and extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges,

and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.

- (g) The joint shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or by external loading.

306.4.3 Connection of plastic and metallic piping.

306.4.3.1 Approved locations. Connections between metallic and plastic piping shall be made outside of buildings underground.

306.4.3.2 Riser connections. When connecting plastic to a metallic riser, there shall be a minimum 12-inch horizontal length of metallic piping underground at the end of any plastic piping installed, and such section of metallic piping shall be suitably protected against corrosion. The metallic piping shall be of adequate length and size so that no stress or strain is placed on the plastic piping.

306.4.3.3 Joints. The connection between the metallic piping and plastic piping shall be a mechanical-joint type or plastic-to-steel transition fitting as recommended by the plastic piping manufacturer.

306.5 Workmanship.

306.5.1 Cleaning. Gas piping and fittings shall be clear and free from cutting burrs and defects in structure or threading, and shall be thoroughly brushed and scale blown.

306.5.2 Defects. Defects in piping or fittings shall not be repaired. When defective piping or fittings are located in a system, the defective piping or fittings shall be replaced.

306.5.3 Welding. All welding of gas systems shall be performed by qualified welders having successfully passed the 6G-position tests of Section IX, Part QW, Article 191.22 of the ASME *Boiler and Pressure Vessel Code*; ASME B31.1 or API 1104; and they shall furnish certification to the Chief Gas Inspector. This will qualify welders for a period of one year. Work on gas systems shall not commence until this provision is satisfied.

306.6 Pipe coating. When in contact with material exerting a corrosive action, metallic piping and fittings shall be coated with a corrosion-resistant material.

306.7 Use of old pipe. Piping, tubing, fittings, valves, etc., removed from any existing installation shall not be used again until they have been thoroughly cleaned, inspected and ascertained to be equivalent to new material.

306.8 Joint compounds. Joint compounds (pipe dope) shall be applied sparingly and only to the male threads of metallic joints. Such compounds shall be resistant to the action of LP gases.

306.9 Bushings. Bushings shall not be used in consumers' gas piping.

306.10 Shutoff valves. Shutoff valves shall comply with ANSI Z21.15, ANSI Z21.21 or ASME B16.33. All valves shall have non-displaceable rotor-members.

SECTION 307 METALLIC PIPE THREADS

307.1 Specifications for metallic pipe threads. Piping and fitting threads shall comply with ANSI/ASME B1.20.1.

307.2 Damaged threads or welds. Piping with threads that are stripped, chipped, corroded or otherwise damaged shall not be used. If a weld opens or defects in lap or butt-welded pipe are evidenced during the operation of cutting or threading, or at any other time, that portion of the pipe shall not be used.

307.3 Number and length of threads. Piping shall be threaded in accordance with Table 307.3.

**TABLE 307.3
SPECIFICATIONS FOR THREADED PIPE**

IRON PIPE SIZE (inches)	APPROXIMATE LENGTH OF THREADED PORTION (inches)	APPROXIMATE NUMBER OF THREADS TO BE CUT
1/2	3/4	10
3/4	3/4	10
1	7/8	10
1 1/4	1	11
1 1/2	1	11
2	1	11
2 1/2	1 1/2	12
3	1 1/2	12
4	1 5/8	13

SECTION 308 CONCEALED PIPING

308.1 General. Gas piping may be installed in concealed locations in accordance with this Section.

308.2 Piping through foundation walls. Gas piping, when installed to pass through the outer foundation wall of a building from below grade outside to above grade inside, shall be encased in a sleeve. The sleeve shall be sealed at the outside of the foundation wall to prevent the entry of water.

308.3 Buried building piping.

308.3.1 Separation. Piping shall not be installed in such a way as to be in contact with the ground or fill under a building or floor slab.

308.3.2 Casing. When the Chief Gas Inspector determines that it is not practical to avoid the installation of building piping that is buried or laid under a floor slab, the gas piping shall be encased in wrought-iron, plastic Schedule 40 pipe or steel pipe. The casing shall extend into a normally usable and accessible portion of the building; the space between the casing; and the gas piping shall be tightly and permanently sealed with approved materials. The casing shall extend at least 4 inches outside the building, and be vented and installed in a way that prohibits the entrance of water. The entire installation shall be such that the gas piping can be readily replaced without damage to the building. Casings in which the design calls for the casing ends to be welded to the carrier piping shall be cathodically protected.

308.4 Piping in solid floors.

308.4.1 Prohibited installations. Piping shall not be installed in solid floor slabs, such as concrete or masonry, unless the Chief Gas Inspector determines there is no other practical manner of installing such piping. For this type of floor construction, the house piping should be installed above the floor, in an open or furred space, hollow partition, hollow wall, attic space or pipe chase.

308.4.2 Alternative methods. Where the Chief Gas Inspector determines that it is not practical to avoid the installation of piping in solid floors, one of the following methods of installation, when approved by the Chief Gas Inspector, shall be followed:

- Piping may be installed in a casing of iron pipe with tightly sealed ends and joints. The casing shall extend at least 2 inches beyond the point where the pipe emerges from the floor, and shall be vented to the outside.
- Piping may be installed in a channel in the floor. Such a channel is to be suitably covered so as to permit access to the piping and prevent the entrance of corrosive materials, or it may be filled with some noncorrosive material that can be removed with minimum damage to the floor.
- Gas piping may be embedded in concrete floor slabs. Steel piping shall be coated with a corrosive-resistant material recommended by the coating manufacturer for underground use and applied in accordance with the manufacturer's installation instructions. Galvanized steel piping with exposed threads shall be coated with corrosion-resistant material in accordance with the provisions of this Paragraph. Piping shall be surrounded with a minimum of 1 1/2 inches of solid concrete and shall not be in physical contact with other metallic structures, such as reinforcing rods or electrically neutral conductors. Necessary precautions shall be observed to prevent piping from being damaged prior to and during the pouring of the floor. Piping shall not be embedded in concrete slabs containing quick-set additives or cinder aggregate.

308.5 Piping passing above grade through solid floors or solid walls. One of the following methods of installation shall be used to install piping above grade through solid floors or solid walls, unless otherwise specified by the Chief Gas Inspector.

- Piping may be installed in a casing or through an opening of adequate size.
- Piping may be encased in a 1:3 mixture of cement and sand with a thickness of not less than 3/4 inch.

308.6 Piping in partitions and walls. Concealed piping may be located in hollow partitions and hollow walls, but shall not be located in solid partitions and solid walls, unless installed in a chase or casing. Tubing in hollow partitions and walls shall be installed in compliance with the provisions of Subsections 902.4 and 1005.3.

308.7 Piping in ceilings and in crawl spaces. Concealed piping may be located in inaccessible ceilings or crawl spaces.

308.7.1 Ventilation of vertical chases. A chase shall be ventilated to the outside and only at the top. The opening shall have a minimum free area, in square inches, equal to the product of one-half of the maximum pressure in the piping (in psig) times the largest nominal diameter of that piping or the cross-sectional area of the chase, whichever is smaller. When more than one fuel-gas piping system is present, the free area for each system shall be calculated and the largest area used.

SECTION 309 INSTALLATION OF PIPING

309.1 Structural safety. The building shall not be weakened by the installation of any gas piping. In the process of installing or repairing any gas piping, the finished floors, walls, ceilings, tile work, or any other part of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the *EPCOT Building Code*.

309.1.1 Cutting, notching and bored holes.

309.1.1.1 Joists. Notches on the ends of joists shall not exceed one-fourth the depth. Holes bored for pipes or cable shall not be within 2 inches of the top or bottom of the joist, and the diameter of any such hole shall not exceed one-third of the depth of the joist. Notches for pipes in the top or bottom of joists shall not exceed one-sixth of the depth, and shall not be located in the middle one-third of the span.

309.1.1.2 Exterior wall and bearing partitions. In exterior walls and bearing partitions, any wood stud may be cut or notched to a depth not exceeding 25 percent of its width. Cutting or notching studs to a depth not greater than 40 percent of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

309.1.1.3 Bored holes in studs. A hole not greater in diameter than 40 percent of the stud width may be bored in any wood stud. Bored holes not greater than 60 percent of the width of the stud are permitted in nonbearing partitions or in any wall where each bored stud is doubled, provided not more than two such successive double studs are so bored.

309.1.1.4 Minimum clearance. In no case shall the edge of the bored hole be nearer than $\frac{5}{8}$ inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

309.2 Piping supports.

309.2.1 General design and installation. Gas piping in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping, and of adequate strength and quality, and located at proper intervals so that the piping cannot be moved accidentally from the installed position. Gas piping shall not be supported by other piping.

309.2.2 Spacing of supports. Vertical gas piping shall be supported at every floor level. Spacing of supports in horizontal gas piping installations shall not be greater than that shown in Table 309.2.

**TABLE 309.2
GAS PIPE AND TUBING SUPPORT SPACING**

SIZE OF PIPE (inches)	SPACING (feet)	TUBING OD (inches)	SPACING (feet)
$\frac{1}{2}$	6	$\frac{3}{8}$ or $\frac{1}{2}$	4
$\frac{3}{4}$ or 1	8	$\frac{5}{8}$ or $\frac{3}{4}$	6
$1\frac{1}{4}$ or larger	10	$\frac{7}{8}$ or larger	8

309.3 Pipe bends.

309.3.1 General. Changes in direction of gas pipe may be made by the use of fittings or by bends made in accordance with the limitations of Subsections 309.3.2 and 309.3.3.

309.3.2 Metallic.

- All bends shall be smooth and free from buckling, cracks or other evidence of mechanical damage, and shall be made only with bending equipment and procedures intended for that purpose.
- The longitudinal weld of the pipe shall be near the neutral axis of the bend.
- Pipe shall not be bent through an arc of more than 90 degrees.
- The inside radius of a bend shall not be less than six times the outside diameter of the pipe.

309.3.3 Plastic.

- Plastic pipe may be bent, provided that the pipe is not damaged and the internal diameter of the pipe is not effectively reduced.
- The radius of the inner curve of such bends shall not be less than 25 times the inside diameter of the pipe.
- If the piping manufacturer specifies the use of special bending equipment or procedures, such equipment or procedures shall be used.

309.4 Drips and grade piping. Except where a dry gas is distributed, or where climatic conditions do not make the following requirements necessary, gas piping shall be properly drained with a minimum slope of approximately $\frac{1}{4}$ inch to 15 feet, and to as few points as practicable. Drips shall be provided at such points to act as storage for condensate and shall be readily accessible for draining. The diameter of the piping constituting the drip shall not be less than that of the line it serves.

309.5 Location limitations.

309.5.1 Prohibited locations. Gas piping inside any building shall not be run in or through an air duct, clothes chute, chimney or vent, ventilating duct, dumbwaiter or elevator shaft. Where the Chief Gas Inspector finds that it is impossible to avoid installing gas piping through or in building duct system for a heating, ventilating or air-conditioning system, the gas piping may be installed in a cas-

ing of noncombustible, rigid, gas-tight material. Such a casing shall comply with Section 311.

309.5.2 Piping in concealed locations. Gas piping shall be prohibited in plenum spaces, unless such spaces are accessible. This provision shall not apply to gas piping in non-plenum concealed locations. Shut-off valves for gas piping shall be prohibited in all concealed locations and all spaces used as plenums.

309.5.3 Unions. Except when located downstream of appliance shutoff valves, all unions are prohibited, unless approved by the Chief Gas Inspector.

309.6 Outlet closures.

309.6.1 Temporary closure. Each outlet, including a valve or stop cock, shall be securely closed, gas tight, with a threaded iron plug or cap immediately after installation, and shall be left closed until an appliance is connected thereto.

309.6.2 Permanent closure. When an appliance is removed from an outlet and the outlet is not to be used again immediately, it shall be securely closed gas-tight by means of a threaded iron plug or cap.

309.6.3 Quick-disconnect devices and gas convenience outlets. The provision of Subsection 309.6.2 does not prohibit the normal use of a listed quick-disconnect device or a listed gas convenience outlet. In no case shall the outlet be closed with tin caps, wooden plugs, cork or similar devices.

309.7 Location of outlets.

309.7.1 General. Outlets must be located in the room or space where the appliance is or may be installed. The unthreaded portion of gas piping outlets shall extend at least 1 inch through finished ceilings, and indoor and outdoor walls, and when extending through floors or outdoor patios and slabs shall not be less than 2 inches above them. The outlet fitting or piping shall be securely fastened. Outlets shall not be placed behind doors. Outlets shall be far enough from floors, walls, patios, slabs and ceilings to permit the use of proper wrenches without straining, bending or damaging the piping.

309.7.2 Quick-disconnect devices and gas convenience outlets. The provisions of Subsection 309.7.1 do not apply to flush-mounted-type, listed quick-disconnect devices or listed gas convenience outlets.

309.8 Prohibited devices. A device shall not be placed inside gas piping or fittings that will reduce the cross-sectional area or otherwise obstruct the free flow of gas. Listed gas filters or other gas filters approved by the Chief Gas Inspector shall not be construed as prohibited devices.

309.9 Branch piping connections.

309.9.1 Sizing. When a branch outlet is placed on a main supply line before it is known what size pipe it will be connected to, the outlet shall be the same size as the supply line.

309.9.2 Tie-in locations. Except in undiluted LP gas supply systems, or where other than dry gas is distributed, all

branch connections shall be taken from the top or sides of horizontal lines and not from the bottom.

309.9.3 Two-way feeds. Gas systems with a two-way feed shall have visible signage marked on both outlets stating:

CAUTION TWO-WAY FEED

309.10 Underground piping. No gas piping shall be placed underground closer than 8 inches from a water pipe or sewer line. Underground gas piping to outside appliance equipment shall be installed at a minimum depth of 12 inches below finished grade. If a minimum of 12 inches of cover cannot be maintained, the pipe shall be installed in conduit or bridged (shielded).

309.11 Separate ditch for gas piping. The laying or installing of gas piping in the same ditch with water, sewer or drainage pipe is prohibited, except when approved by the Chief Gas Inspector.

309.12 Grounding of gas piping.

309.12.1 Electrical bonding. Gas piping systems within a building and other above-ground gas piping shall be electrically continuous and bonded to a grounded electrode as defined by NFPA 70.

309.12.2 Prohibition. Gas piping shall not be used as a grounding electrode.

309.13 Protection against corrosion. When dissimilar metals are joined underground, an insulated coupling shall be used. Metallic gas galvanized piping that is in contact with soil or other corrosive materials shall be protected from corrosion. Metallic piping shall not be laid in contact with cinders, mortars or other corrosive materials without protection from corrosion. The National Association of Corrosion Engineers (NACE) standards shall be used as a minimum in the design, installation and testing of systems.

309.14 Plastic piping limitations.

309.14.1 Limitations. Plastic piping must be buried underground for its entire length, and may not be used within or under any building or slab.

309.14.2 Maximum operating pressures. Plastic piping shall not be used for consumers' gas piping when operating pressures are in excess of 5 psi, unless approved by the Chief Gas Inspector.

309.15 Flanges.

309.15.1 General requirements. All flanges shall comply with ASME B16.1, ASME B16.20 or MSS SP-6. The pressure-temperature ratings shall equal or exceed that required by the application.

309.15.2 Flange facings. Standard facings shall be permitted for use under this Code. Where 150-pound pressure-rated steel flanges are bolted to Class 125 cast-iron flanges, the raised face on the steel flange shall be removed.

309.15.3 Lapped flanges. Lapped flanges shall be used only above ground or in exposed locations accessible for inspection.

SECTION 310 GAS SHUTOFF VALVES

310.1 Accessibility of gas valves. Shutoff valves controlling separate piping systems shall be placed an adequate distance from each other so they will be readily accessible for operation, and shall be installed so as to be protected from damage. They shall be plainly marked with an identification tag attached by the installer so that the piping systems supplied through them can be readily identified. The shutoff valve, regulator, and/or gas shut-off solenoid for any grease hood shall not be located under the hood.

310.2 Shutoff valves for multiple house lines.

310.2.1 Multiple-tenant building. In multiple-tenant buildings, where a common piping system is installed to supply other than one- or two-family dwellings, shutoff valves shall be provided for each tenant or for each separate house line at a point of easy accessibility to each apartment.

310.2.2 Individual buildings. In a common system servicing a number of individual buildings, shutoff valves shall be installed outside at each building.

SECTION 311 TEST OF PIPING FOR TIGHTNESS

311.1 Procedure and precautions. Before any system of consumers' gas piping is put in service, it shall be tested to ensure that it is gas tight. When repairs or additions are made following the pressure test, the affected piping shall be tested. When minor repairs or additions are made, a careful inspection of the work and a test of the connections with a leak-detecting solution, or other leak-detecting methods, shall be performed. Where any part of the system is to be enclosed or concealed, this test should precede the work of closing in. To test for tightness, the piping shall be filled with air or inert gas. In no case shall oxygen be used.

311.2 Method of testing. Gas piping shall withstand a test pressure of at least $1\frac{1}{2}$ times the maximum working pressure, but not less than 5 psig. Where the test pressure exceeds 125 psig, the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.

311.3 Test instruments. For these tests, pressure shall be measured with a manometer or slope gage, or other accurate and sensitive pressure-indicating device, designed and calibrated to read, record or indicate a pressure loss due to leakage, the scale of which is so graduated that variations in pressure may be accurately read. All necessary apparatus for conducting the pressure test shall be furnished by the installer. The test source shall be isolated or disconnected prior to beginning the time test duration.

311.4 Test duration. Test duration shall be not less than $\frac{1}{2}$ hour for each 500 cubic feet of pipe volume or fraction thereof. For piping systems having a volume greater than 24,000 cubic feet, the duration of the test shall not exceed 24 hours.

311.5 Operational test. Immediately after the gas has been introduced into a new system or reintroduced (after repairs or interruption in service), the entire system shall be inspected for leakage by means of a combustion gas detector.

SECTION 312 TURNING ON GAS

312.1 Close all gas outlets. Before turning gas into any piping, all openings from which gas can escape shall be closed.

312.2 Checking for leakage. Immediately after turning gas into a piping system, a thorough check shall be made to ascertain that no gas is escaping.

SECTION 313 PURGING

313.1 Purge all gas lines. After the piping system has been checked for leakage, it shall be purged. Under no circumstances shall a line be purged into the combustion chamber of an appliance. The open end of the piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition, unless precautions are taken to perform this operation in a safe manner by ventilating the space, controlling the purge rate and eliminating all hazardous conditions.

313.2 Light pilots. When an appliance is put in service, the appliance shall be purged and the pilots lighted.

SECTION 314 OUTSIDE USE OF PIPE OR TUBING

314.1 Metallic tubing. Regardless of any installation or sizing requirements in this or any other Section, smaller pipe, seamless copper or coated steel tubing of adequate size, installed entirely outside a building, may be used to connect gaslights and grills located outside a building.

314.2 Plastic tubing. Regardless of any sizing requirements in this or any other section, plastic tubing of adequate size may be used, underground only, to connect gaslights and grills located outside a building.

SECTION 315 MANUFACTURED HOME AND TRAILER PARKS

315.1 Compliance. Gas piping systems in manufactured home parks and travel trailer parks extending from the point of delivery to the terminal of the gas riser at each trailer site shall comply with the following specific provisions and with all the applicable provisions in this Chapter and Chapter 1.

315.2 Protection of piping. Piping shall be buried to a sufficient depth or covered in a manner so as to protect the piping system from physical damage.

315.3 Prohibited locations. Piping shall not be installed underground beneath manufactured homes or travel trailers with an enclosed foundation.

315.4 Location, protection and sizing of riser. Where information is not available on the location of the trailer supply connection, the gas riser to each trailer site should be placed in the rear one-third section of the site and not less than 18 inches from the roadside wall of the trailer. It shall be located and protected or supported so as to minimize the likelihood of damage by moving vehicles. When the gas pressure at the terminal of the gas riser at each trailer site is $\frac{1}{2}$ psi or less, the

minimum size of the gas piping outlet shall be $\frac{3}{4}$ inch for other than undiluted LP gases.

315.5 Location of shutoff valves. Outlets for the individual trailers and gas piping to any building supplied by the system shall be provided with a readily accessible manual shutoff valve.

315.6 Connection of trailer. Trailers shall be connected to the gas piping system with rigid pipe or listed connectors approved by AGA 3 or semirigid tubing of adequate size, and installed so as to be protected against physical damage. Provisions for flexibility shall be provided when necessary.

CHAPTER 4

APPLIANCE INSTALLATION

SECTION 401 GENERAL

401.1 General. This Chapter provides the fundamental requirements for the installation of any gas appliance or accessory. In addition to the provisions of this Section, the provisions of Chapters 1, 5, 6, 7 and 8 shall be strictly observed. The installing agency shall be responsible for complying with these requirements.

SECTION 402 REQUIREMENTS

402.1 Approval installation of listed or unlisted equipment. Listed appliances and equipment shall be installed in accordance with their listing. Unlisted appliances and equipment shall be installed in accordance with the manufacturer's installation instructions, this Code and the Chief Gas Inspector.

402.2 Type of gas. It shall be determined that the appliance has been designed for use with the gas to which it will be connected. No attempt shall be made to convert the appliance from the gas specified on the rating plate for use with a different gas without consulting the gas utility company or the manufacturer for complete instructions.

402.3 Clearances. All gas appliances and their flue or vent connectors shall be installed so that continued or intermittent operation will not create a hazard to persons or property. Minimum clearances between combustible walls and the back and sides of various conventional types of appliances, and their flue or vent connectors, are specified in Chapters 5 and 6.

402.4 Air for combustion and ventilation.

402.4.1 Appliance location. Appliances shall be installed in a location in which the facilities for ventilation permit the satisfactory combustion of gas and proper venting under normal conditions of use. While all forms of building construction cannot be covered in detail, this requirement shall be met by application of one of the methods contained in Subsections 402.4.2 and 402.4.3 for ordinary building construction.

402.4.2 Exemptions. The provisions of this Section are not intended to apply to:

- (a) Direct-vent appliances that are constructed and installed so that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere.
- (b) Enclosed furnaces that incorporate an integral total enclosure and use only outside air for the combustion and dilution of flue gases.
- (c) Appliances installed in garages.

402.4.3 Unconfined spaces. Where appliances are installed in unconfined spaces in buildings of conventional frame, brick or stone construction, infiltration is normally adequate to provide air for combustion and draft hood dilution.

Exception: Where appliances are installed in unconfined spaces within a building of unusually tight construction, air for combustion, ventilation and draft hood dilution must be obtained from the outdoors or from spaces freely communicating with the outdoors. Under these conditions, a permanent opening or openings shall be provided and located and sized in compliance with the provisions of Subsection 402.4.4.3 or 402.4.4.4.

402.4.4 Confined spaces.

402.4.4.1 All air from inside. Where appliances are installed in a confined space, provisions shall be made for supplying the space with air for the combustion, ventilation and dilution of flue gases. This may be accomplished through the use of two permanent openings that freely communicate with an additional room of sufficient volume so that the combined volume of all spaces meets the criteria for an unconfined space (see Figure 402.4A), or by complying with the provisions of Subsection 402.4.4.2. The total input of all appliances installed in the combined space shall be considered in making this determination. The two permanent openings shall each have a free area of not less than 1 square inch per 1,000 Btu per hour (Btu/h) of the total input rating of all appliances in the confined space, but not less than 100 square inches. One opening shall be within 12 inches of the top of the confined space and one within 12 inches of the bottom. If necessary, continuous ducts, having cross-sectional areas at least equal to the free area of the opening, shall be utilized to connect with the source of the air supply.

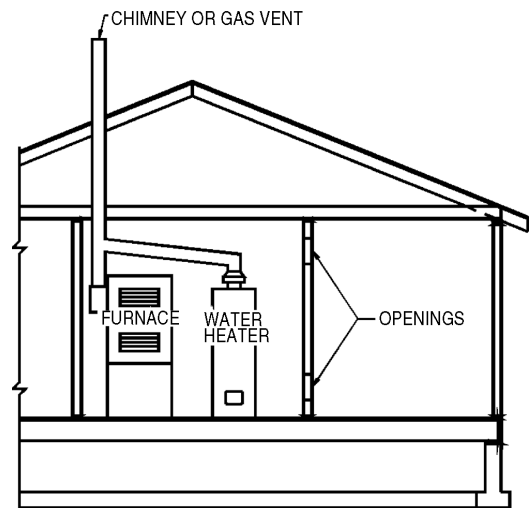


FIGURE 402.4A
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM INSIDE THE BUILDING
SEE SUBSECTION 402.4.4.1

Note: Each opening shall have a free area of not less than 1 square inch per 1,000 Btu/h of the input rating of all appliances in the enclosure, but not less than 100 square inches.

ply. The minimum dimensions of rectangular air ducts shall be not less than 3 inches. Any duct from the top opening must be horizontal or pitched upward. (See Figure 402.4D.)

Exception: Where appliances are installed in a confined space within a one- or two-family residence, provisions shall be made for supplying this space with air for combustion and ventilation by eliminating the ceiling of the confined space; provided, however, that the area above this confined space freely communicates with the outdoors.

402.4.4.2 All air from outdoors. Where appliances are installed in a confined space and all air for combustion and ventilation is obtained from the outdoors, the confined space shall be provided with one or two permanent openings, in compliance with the provisions of Subsection 402.4.4.3 or 402.4.4.4.

402.4.4.3 One-permanent-opening method. When one opening is used and the appliance has a minimum clearance of 1 inch on the sides and back, and 6 inches on the front, the opening shall be within 12 inches of the top of the confined space. The opening shall communicate directly, or by ducts, with the outdoors or spaces (attic) that freely communicate with the outdoors, as follows:

- When communicating with the outdoors through an opening, or vertical or horizontal duct, the opening shall have a minimum free area of 1 square inch per 3,000 Btu/h of the input rating of all appliances in the enclosure, but no smaller than the vent flow area.
- When a duct is used, it shall have at least the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of the rectangular air duct shall not be less than 3 inches.
- In calculating free area, consideration shall be given to the blocking effect of a louver, grille or screen protecting the opening.
- The duct or opening for combustion or ventilation air shall be covered with a corrosion-resistant screen of not less than 1/4-inch mesh.

402.4.4.4 Two-permanent-opening method. When two openings are provided, one opening shall be within 12 inches of the top and one within 12 inches of the bottom of the enclosure, with each opening having a minimum free area of 19 square inches. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors, as follows:

- When directly communicating with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/h of the total input rating of all appliances in the enclosure. (See Figure 402.4B.)
- When directly communicating with the outdoors through vertical ducts, each opening shall have a

minimum free area of 1 square inch per 4,000 Btu/h of the total input rating of all appliances in the enclosure. (See Figure 402.4C.)

- When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch per 2,000 Btu/h of the total input rating of all appliances in the enclosure. (See Figure 402.4D.)

- When ducts are used, they shall have at least the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall not be less than 3 inches. Any duct from the top opening must be horizontal or pitched upward.

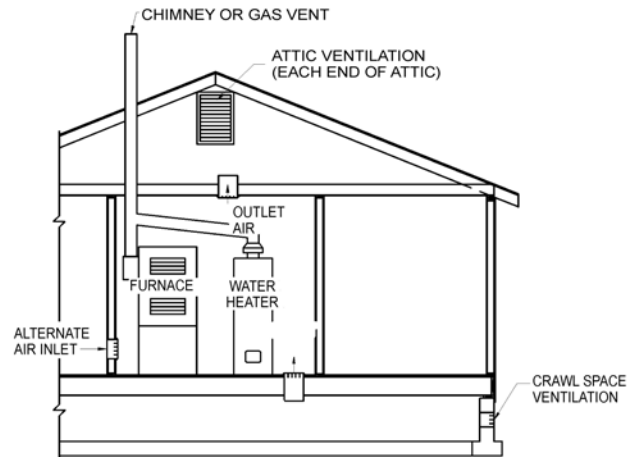


FIGURE 402.4B
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM OUTDOORS—INLET AIR FROM VENTILATED
CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC
SEE SUBSECTION 402.4.4(1)

Note: The inlet and outlet air openings shall each have a free area of not less than 1 square inch per 4,000 Btu/h of the total input rating of all appliances in the enclosures.

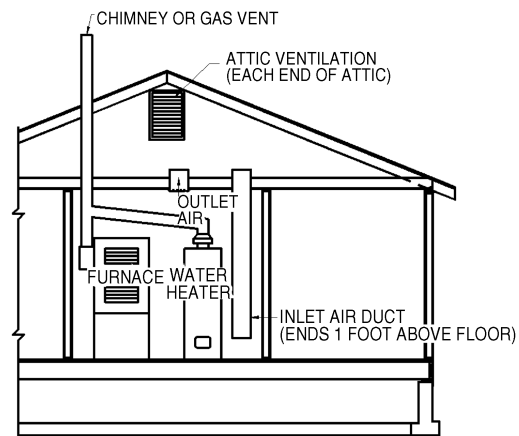


FIGURE 402.4C
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC
SEE SUBSECTION 402.4.4(2)

Note: The inlet and outlet air openings shall each have a free area of not less than 1 square inch per 4,000 Btu/h of the total input rating of all appliances in the enclosure.

- (e) In calculating free area, consideration shall be given to the blocking effect of a louver, grille or screen protecting the opening.
- (f) Ducts or openings for combustion or ventilation air shall be covered with a corrosion-resistant screen of not less than 1/4-inch mesh.

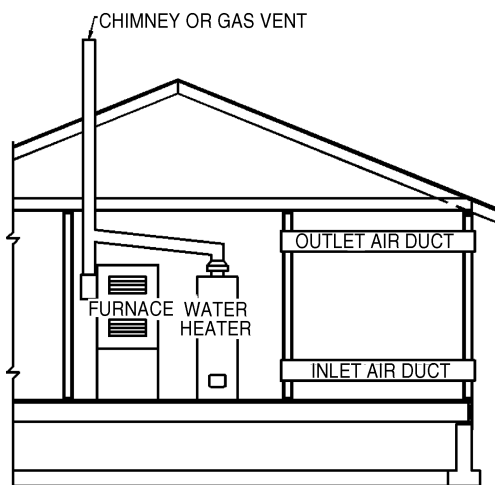


FIGURE 402.4D
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM OUTDOORS THROUGH DIRECT DUCTS
SEE SUBSECTION 402.4.4.4(3)

Note: Each air duct opening shall have a free area of not less than 1 square inch per 2,000 Btu/h of the total input rating of all appliances in the enclosure. If the appliance room is located against an outside wall and the air openings communicate directly with the outdoors, each opening shall have a free area of not less than 1 square inch per 4,000 Btu/h of the total input rating of all appliances in the enclosure.

402.4.5 Unlisted boilers. The size of the combustion air openings specified in Subsection 402.4 shall not govern an installation covered by Section 802.

402.4.6 Potential impacts. Operating exhaust fans, kitchen ventilation systems or fireplaces will potentially create conditions that require special attention to avoid unsatisfactory appliance operation.

402.4.7 Clothes dryers. When a Type I clothes dryer is installed in a confined space with other vented appliances, regardless of the energy source, the size of the lower opening, specified in Subsection 402.4.5, the free area shall be increased by 60 square inches of free opening to provide air for blower of clothes dryer.

402.5 Venting. Appliances shall be vented in accordance with the provisions of Chapter 6.

402.6 Flammable vapors. In industrial and commercial establishments, gas appliances shall not be installed in any location where flammable vapors are likely to be present, unless the design, operation and installation are such as to eliminate the possible ignition of the flammable vapors.

402.7 Installation in garages.

402.7.1 Elevation of ignition source. Gas appliances in residential garages shall be installed so that all burners and burner-ignition devices are located not less than 18 inches above the floor.

402.7.2 Protection from moving vehicles. Gas appliances shall be located, or reasonably protected, so that they are not subject to physical damage by a moving vehicle.

402.8 Accessibility. Every appliance shall be located so that it will be accessible for operation and servicing. For attic installation, the passageway and servicing area adjacent to the appliance shall be floored. Such attics shall have flooring under and around such water heaters or gas appliances, and shall be provided with a continuous floored passageway at least 2 feet wide.

402.9 Strain on connection. Gas appliances shall be adequately supported and so connected to the piping as not to exert undue strain on the connection.

402.10 Extra device or attachment. A device or attachment shall not be installed on any appliance that shall, in any way, impair the combustion of gas.

402.11 Combination of appliances. Any combination of appliances, attachments or devices used together in any manner shall comply with the standards that apply to the individual appliances.

402.12 Use of air or oxygen under pressure. Where air or oxygen under pressure is used in connection with the gas supply, effective means shall be provided to prevent the air or oxygen from passing back into the gas piping. The gas utility company shall be consulted for details.

402.13 Venting of pressure regulators.

402.13.1 General. Gas appliance pressure regulators requiring access to the atmosphere for successful operation shall be equipped with vent piping leading to the outer air or into the combustion chamber adjacent to a constantly burning pilot, unless such regulators are listed and are of a type constructed to limit the escape of gas from the vent opening in the event of a diaphragm failure. Where vents lead to the outer air, means shall be designed to prevent water from entering this piping, and also to prevent the entry of insects and foreign matter. In instances where vents enter the combustion chamber, the vents shall be located so that the escaping gas will be readily ignited from the pilot flame and the heat released will not adversely affect the operation of the thermal element of the safety shutoff device. The terminus of the vent shall be securely held in a fixed position relative to the pilot flame.

402.13.2 Independent vents. An MP regulator not equipped with vent-limiting means shall have an adequately sized independent vent installed at a safe point outside the building. The vent size shall be at least as large as the vent connection on the regulator. Means shall be provided to prevent water from entering this piping, and also to prevent the entry of insects and foreign matter.

402.14 Automatic controls. The installation of automatic off and on controls on any appliance is prohibited, unless the appliance is equipped with a listed safety shutoff device. For information governing the installation and use of automatic controls for conversion burners, see Section 512, and for unlisted boilers, see Chapter 8.

402.15 Installation instructions. The installing agency shall conform to the appliance manufacturer's specific recommen-

dations when completing an installation to ensure satisfactory performance and serviceability. The installing agency also shall leave the manufacturer's installation, operating and maintenance instructions in a location on the premises where they will be readily available for reference and guidance for the Chief Gas Inspector, servicemen, and the owner or operator.

402.16 Engineered installations. Engineered combustion air installations shall provide an adequate supply of combustion, ventilation and dilution air and shall be approved.

402.17 Mechanical combustion air supply. Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from the outdoors at a rate not less than 0.35 cubic feet per minute per 1,000 Btu/h of total input rating of all appliances located within the space.

402.17.1 Makeup air. Where exhaust fans are installed, makeup air shall be provided to replace the exhausted air.

402.17.2 Appliance interlock. Each of the appliances served shall be interlocked with the mechanical air supply system to prevent main burner operation when the mechanical air supply system is not in operation.

402.17.3 Combined combustion air and ventilation air system. Where combustion air is provided by the building's mechanical ventilation system, the system shall provide the specified combustion air rate in addition to the required ventilation air.

SECTION 403

APPLIANCE CONNECTIONS TO BUILDING PIPING

403.1 Connecting gas appliances.

403.1.1 General. Gas appliances shall be connected to the building piping by one of the following:

- (a) Rigid metallic pipe and fittings.
- (b) Semi-rigid metallic tubing and metallic fittings. When approved by the Chief Gas Inspector, lengths greater than 6 feet shall be used and need not be in the same room as the appliance. Semirigid metallic tubing shall not enter a motor-operated appliance through an unprotected knockout-plug.
- (c) Listed gas appliance connectors used in accordance with the terms of their listing that are completely in the same room as the appliance.
- (d) Listed quick-disconnect devices in conjunction with listed gas appliance connectors.
- (e) Listed gas convenience outlets in conjunction with listed gas appliance connectors.
- (f) Listed gas hose connectors in accordance with Subsection 403.2.
- (g) Listed appliance connectors complying with ANSI Z21.69 for gas food-service equipment listed for use with casters or otherwise subject to movement for cleaning, and other large and heavy gas utilization equipment that may be moved.

- (h) In accordance with Paragraphs (b) and (c), the connector or tubing shall be installed so as to be protected against physical damage.

403.1.2 Gas shutoff valves or convenience outlets. Each gas appliance shall have an accessible gas shutoff valve or listed gas convenience outlet located not greater than 6 feet from the appliance; installed upstream from the union, connector or quick-disconnect device they serve; and in the same room as the appliance. This Subsection shall not prohibit the use or installation of gas shutoff valves in the firebox of fireplaces serving listed gas decorative appliances.

403.2 Gas hose connectors for portable gas-fired appliances.

403.2.1 Indoor use only.

403.2.1.1 Limitations. The connection of an appliance with any type of gas hose is prohibited, except when used with laboratory, shop or ironing equipment that requires mobility during operation. Such connections shall have the shutoff valve or stop cock installed at the connection to the house piping. Where the gas hose is used, it shall be a minimum practical length not to exceed 6 feet, and shall not extend from one room to another, nor pass through any walls, partitions, ceilings or floors. Under no circumstances shall gas hose be concealed from view or used in a concealed location. In commercial kitchen applications, all hoses shall be tethered to the appliance so as not to lay on the floor when disengaged. All appliances with hose connections shall have the female disconnect portion with check valve assembly attached to the gas piping shutoff valve. All appliances shall be tethered so as not to create a strain on the hose connection.

403.2.1.2 Listing required. Only listed gas hose shall be used. Listed gas hose shall be used only in accordance with its listing. Gas hose shall not be used where it is likely to be subject to temperatures greater than 125°F.

403.2.1.3 Portable indoor appliances. Gas hose connectors for portable gas-fired indoor appliances are limited for use with fuel gases having a specific gravity of less than 1.0.

403.2.2 Outdoor use only. Portable, outdoor gas-fired appliances may be connected with gas hose connectors listed for that purpose. The length of assembled connectors shall be limited to 15 feet. A shutoff valve, listed quick-disconnect device or stop cock shall be installed where the connector is attached to the supply piping and in such manner to prevent the accumulation of water or foreign matter.

SECTION 404

ELECTRICAL CONNECTORS

404.1 Electrical connectors. All electrical connections between gas appliances and the building wiring shall conform to NFPA 70.

404.2 Electrical ignition and control devices. Devices employing or depending upon an electrical current shall not be used to control or ignite a gas supply if of such character that failure of the electrical current could result in the escape of unburned gas or in failure to reduce the supply of gas under conditions that would normally result in its reduction unless other means are provided to prevent the development of dangerous temperatures, pressures or the escape of gas.

404.3 Electrical ground. Gas piping shall not be used as a grounding electrode for an electric fuse panel, telephone circuit or lightning arrestor, nor shall electric circuits utilize gas piping, casing of controls, panels or other metal parts in lieu of wiring. This provision shall not apply to low-voltage control and ignition circuits, and to electronic flame-detection device circuits incorporated as part of the appliance.

404.4 Electrical circuit. The electrical circuit employed for operating the automatic, main gas control valve, safety shut-off device, room temperature thermostat, limit control or other electrical devices used with the gas appliance shall be in accordance with the wiring diagrams supplied with the appliance.

404.5 Continuous power. All gas appliances using electrical controls shall have the controls connected to a permanently live electrical circuit that is not controlled by a light switch.

SECTION 405 OUTDOOR ROOFTOP INSTALLATIONS

405.1 General.

405.1.1 Listing and design. Appliances shall be listed for outdoor installation and shall be designed to withstand atmospheric and climatic conditions in the areas in which they are to be installed.

405.1.2 Structural design. Roofs on which appliances are to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load.

405.2 Installation.

405.2.1 General. Appliances shall be installed in accordance with their listings and the manufacturer's installation instructions.

405.2.2 Standing water provisions. Appliances shall be installed on a well-drained surface. Where standing water occurs on the roof or in the passageways where the appliance is located, or when the roof has a water-seal design, a suitable platform or walkway, or both, shall be provided above the waterline.

405.2.3 Fall protection. A minimum 6-foot clearance shall be available between the appliance and the edge of a roof or similar hazard, or rigidly fixed rails or guards a minimum of 3 feet high shall be provided on the exposed side except that parapets or other building structures a minimum of 3 feet high may be utilized in lieu of rails or guards.

405.3 Access to appliances. Appliances located on the roof or other elevated locations shall be accessible.

Exception: When the roof is less than 20 feet above grade, the use of portable means of access is acceptable.

SECTION 406 MANUFACTURED HOMES

406.1 Safety standards. Appliance installations in mobile homes shall comply with the provisions of the Department of Housing and Urban Development's 24 CFR, Part 3280, *Manufactured Home Construction and Safety Standards*.

SECTION 407 AIRCRAFT HANGAR INSTALLATIONS

407.1 General. Appliances in aircraft hangars shall be listed for such installation and shall be installed in accordance with the terms of their listing, the manufacturer's instructions and the requirements of this Code. This Section shall not be construed to supersede any applicable *EPCOT Building Code* requirements.

CHAPTER 5

INSTALLATION REQUIREMENTS FOR SPECIFIC APPLIANCES

SECTION 501 GENERAL

501.1 Scope. This Chapter provides the fundamental requirements of the installation practices for specific types of appliances. The installing agency shall be responsible for complying with the provisions of this Chapter, as well as Chapters 4, 6 and 7.

501.2 Installation. When the installation requirements for a listed appliance or accessory conflict with the provisions of this Code, the appliance or accessory shall be installed according to its listing. The installing agency shall comply with the instructions on the appliance rating plates and additional marking requirements, as well as the manufacturer's installation and operation instructions, when installing gas appliances and equipment.

SECTION 502 DOMESTIC RANGES

502.1 Clearance from combustible construction. Listed domestic ranges, when installed on combustible floors, shall be set on their own bases or legs, and shall be installed with clearances of not less than that shown on the marking plate. When clearance information is not available on the marking plate, the range shall be installed with clearances of not less than those shown in Table 502.1. The clearance shall not interfere with the requirements for combustion air, accessibility for operations, or servicing.

502.2 Built-in cooking units. Listed, built-in domestic cooking units or ranges, designed for installation as part of the counter, shall be installed in accordance with their listing and the manufacturer's installation instructions.

502.3 Install level. Ranges shall be installed so that the cooking tops and oven racks are level.

SECTION 503 OPEN-TOP BROILER UNITS FOR INDOOR USE

503.1 Open-top broiler unit hoods. Listed, domestic, open-top broiler units shall be installed in accordance with their listing and the manufacturer's installation instructions. A ventilation hood shall be provided above an open-top broiler unit, unless otherwise listed for forced down draft ventilation. A minimum clearance of 24 inches shall be maintained between the cooking top and combustible material above the hood. The hood shall be at least as wide as the open-top broiler unit and centered over the unit.

TABLE 502.1
CLEARANCES FOR DOMESTIC RANGES
WITHOUT MARKING INFORMATION

TYPE OF RANGE	SPACING OF CENTER LINE OF TOP BURNERS FROM SIDE OF RANGE (inches)	MINIMUM DISTANCE FROM COMBUSTIBLE MATERIAL (inches)			
		Sides		Rear	
		Wall not extending above cooking top	Wall extending above cooking top	Body of range	Projecting flue box
Insulated	Less than 10	1/2	4 1/2	1	1
Insulated	10 or more	1/2	1/2	1	1
Flush to wall	Less than 10	Flush	4 1/2	Flush	—
Flush to wall	10 or more	Flush	Flush	Flush	—

SECTION 504 WATER HEATERS

504.1 Prohibited installations. Water heaters, with the exception of those having direct-vent systems, shall not be installed in bathrooms and bedrooms, or in a closet with access only through a bedroom or bathroom. However, water heaters of the automatic-storage type may be installed as a replacement in a bathroom, when specifically authorized by the Chief Gas Inspector, provided they are properly vented and supplied with adequate combustion air.

Exception: When a closet, having a weather-stripped solid door with an approved door-closing device, has been designed exclusively for the water heater, and where all air for combustion and ventilation is supplied from the outdoors.

504.2 Location.

504.2.1 Proximity to vent. Water heaters shall be located as close as practicable to the vent. They should be so located as to provide short runs of water piping to fixtures.

504.2.2 Appliances in attic. All water heaters installed in remote locations such as suspended ceiling spaces or in attics shall rest in a galvanized steel or other metal pan of equal corrosion resistance having a thickness at least equal to 0.0276-inch galvanized sheet steel. Pans shall have a minimum depth of 1 1/2 inches. All drain pans shall have a minimum 1-inch drain. (See Subsection 504.7 of the *EPCOT Plumbing Code* for other safety pan requirements.)

504.3 Clearance. Gas-fired water heaters shall be positioned in relation to combustible construction with a minimum clearance in accordance with Table 504.3. In no case shall the clearance be such as to interfere with the requirements for combustion air and accessibility. (See Subsections 402.4 and 402.7.)

TABLE 504.3
MINIMUM CLEARANCES FOR LISTED
WATER HEATERS, UNLESS OTHERWISE MARKED

TYPE MATERIAL OF HEATER	DISTANCE FROM COMBUSTIBLE	
	Nearest part of jacket	Flat side
Type A ^a	6 inches	—
Type B ^b	2 inches	—
Type C ^c	—	Flush
Counter type unit ^d	In accordance with manufacturer's instructions	—

Notes:

- a. Type A—Miscellaneous (including circulating tank and instantaneous).
- b. Type B—Underfired, insulated automatic storage heaters.
- c. Type C—Type B units with one or more flat sides and tested for installation flush to wall.
- d. Counter type—Type B units specifically designed for installation in or beneath a counter.

504.4 Connections. Water heaters shall be connected in a manner to permit observation, maintenance and servicing.

504.5 Closed systems. Water heaters shall not be installed in a closed system of water piping, unless a water pressure relief valve is provided. All closed systems are required to have expansion tanks to absorb pressure-heat gains; this shall not be achieved by relieving the water pressure relief valve.

504.6 Temperature, pressure and vacuum relief valves.

504.6.1 Installation and adjustment. The installation and adjustment of the temperature, pressure and vacuum relief valves, or combination thereof, and automatic gas shutoff valves, shall be in accordance with the requirements of ANSI Z21.10.1 and ANSI Z21.10.3, or with the manufacturer's installation instructions.

504.6.2 Water supply located at the bottom of the tank.

A water heater or tank that has the cold water supply entering at the bottom of the tank shall have a listed vacuum relief valve installed above the top of the tank so as to prevent siphonage.

504.7 Circulation or tank types.

504.7.1 Connection method. The method of connecting a circulating water heater to the tank shall ensure the proper circulation of water through the heater, and permit a safe and useful temperature of water to be drawn from the tank.

504.7.2 Piping size. The size of the water circulating piping, in general, shall conform to the size of the water connections of the heater.

504.7.3 Water valve or cock. A water valve or cock, through which sediment may be drawn off or the tank emptied, shall be installed at the bottom of the tank.

504.7.4 Siphoning is prohibited. A method approved by the Chief Gas Inspector shall be provided to prevent siphoning in boilers or tanks that are connected to a water heater.

SECTION 505
ROOM HEATERS

505.1 General installation.

505.1.1 Listed unvented heaters. Listed, unvented room heaters shall be installed in accordance with their listing and the manufacturer's installation instructions. Unvented room heaters shall not have an input rating in excess of 40,000 Btu per hour (Btu/h) and shall not be installed in bedrooms.

Exception: Listed, unvented room heaters for installation in bedrooms shall not have an input rating in excess of 10,000 Btu/h. Listed, unvented room heaters for installation in bathrooms shall not have an input rating in excess of 6,000 Btu/h.

505.1.2 Listed vent heaters. Listed, vented room heaters shall be installed in accordance with their listing and the manufacturer's installation instructions.

505.2 Clearance. Listed, room heaters shall be installed with clearances of not less than those specified in Table 505.2, except when appliances are listed for installation at a lower clearance, then those appliances shall be installed in accordance with their listing. The clearance shall not interfere with the requirements for combustion air and accessibility. Room heaters designed and marked: "For use in noncombustible, fire-resistant fireplace only," shall be installed as listed. (See Subsections 402.4 and 402.7.)

TABLE 505.2
MINIMUM CLEARANCES FOR LISTED
ROOM HEATERS, UNLESS OTHERWISE MARKED

TYPE	DISTANCE FROM COMBUSTIBLE CONSTRUCTION	
	Jacket sides and rear	Projecting flue box or draft hood
Warm-air circulators	6 inches	2 inches
Radiant heaters	6 inches	2 inches
Wall heaters	Flush	—

505.3 Wall-type room heaters. Wall-type room heaters shall not be installed in or connected to walls of combustible construction, unless listed for such installation.

505.4 Installations in bedrooms.

505.4.1 Gas-fired, vented heaters. Gas-fired, vented heaters installed in bedrooms or other normally closed-off rooms shall be connected to a chimney or gas vent, and equipped with a safety shutoff device.

505.4.2 Gas-fired, unvented heaters. Gas-fired, unvented heaters installed in bedrooms, bathrooms or other normally closed-off rooms shall be wall-mounted.

505.5 Installations in institutions. Room heaters installed in any location within institutions, such as assisted living facilities, mental-health facilities, convalescent facilities and group homes, shall be of the vented type and shall be connected to an effective chimney or gas vent and equipped with a safety shutoff device.

505.6 Oxygen depletion safety shutoff system (ODS). All unvented room heaters shall be equipped with an oxygen depletion sensitive safety shutoff system. The system shall shut off the gas supply to the main and pilot burners when the oxygen in the surrounding atmosphere is depleted to the percent concentration specified by the manufacturer, but not lower than 18 percent. The system shall not incorporate field adjustment means capable of changing the setpoint at which the system acts to shut off the gas supply to the room heater.

SECTION 506 VENTED DECORATIVE APPLIANCES

506.1 Installation.

506.1.1 General. Listed, vented decorative appliances shall be installed in accordance with their listing and the manufacturer's installation instructions.

506.1.2 Access. Panels, grilles and access doors that must be removed for normal servicing operations shall not be attached to the building.

506.1.3 Location. Vented decorative appliances shall be located so as not to create a hazard to walls, floors, curtains or doors.

506.2 Manual main shutoff valve. A manual, main shutoff valve may be installed ahead of all controls, including the pilot gas valve.

506.3 Combustion and circulation air. Combustion and circulation air shall be provided in accordance with Subsection 402.4.

SECTION 507 CENTRAL HEATING BOILERS AND FURNACES

507.1 Prohibited location. Central heating boilers and furnaces using solid, liquid or gas fuel, except direct-vent or heating coils located in air-handling units, shall not be installed:

- (a) Under a stairway.
- (b) In a room used as a bedroom, bathroom or in a closet with access through a bedroom or bathroom.

Exception: When a closet, which includes a weather-stripped solid door with an approved door-closing device, has been designed for the central furnace and where all air for combustion and ventilation is supplied from the outdoors.

507.2 Manual shutoff valves.

507.2.1 Complete shutoff safety shutoff device is not used. When a complete, shutoff-type safety device is not used, a manual shutoff valve shall be provided ahead of all controls, except the manual pilot gas valve.

507.2.2 Complete shutoff safety shutoff device is used. When a complete, shutoff-type safety device is used, a manual shutoff valve shall be provided ahead of all controls. A manual shutoff valve shall be provided for shutting off the main gas burner independently of the gas pilot.

507.2.3 Union connection location. A union connection shall be provided downstream from the manual shutoff

valve to permit the removal of controls, including the safety shutoff device.

507.3 Clearances. Listed, central heating boilers and furnaces shall be installed with clearances of not less than those specified in Table 507.3, except when appliances are listed for installation at a lower clearance, then the appliance may be installed in accordance with their listing. The clearance shall not interfere with the requirements for combustion air and accessibility. (See Subsections 402.4 and 507.5.)

**TABLE 507.3
MINIMUM CLEARANCES FOR LISTED CENTRAL HEATING
BOILERS AND FURNACES, UNLESS OTHERWISE MARKED**

	MINIMUM CLEARANCE (inches)				
	Above and sides of bonnet or plenum	Jacket sides and rear	Front ^a	Projecting flue box or draft hood	Vent ^b connector
I. Listed, automatically fired, forced-air or gravity system, with 250°F temperature limit control.	2 ^{c, d}	6	18	6	6
II. Listed, automatically fired heating boilers—Steam boilers operating at a pressure of not greater than 15 psi and hot water boilers operating at not greater than 250°F.	6 ^e	6	18	6	6

- a. Front clearances shall be as required by the manufacturer for servicing the burner and furnace or boiler.
- b. The vent connector clearance does not apply to listed, Type B gas vents.
- c. The clearance may be reduced to 1 inch for a listed, forced-air or gravity furnace equipped with a limit control that cannot be set higher than 200°F or marked to indicate that the outlet air temperature cannot exceed 200°F.
- d. Clearance from supply ducts within 3 feet of the plenum shall not be less than that specified from the bonnet or plenum. No clearance is required beyond this distance.
- e. This clearance is above the top of the boiler.

507.4 Erection and mounting.

507.4.1 General. A central heating boiler or furnace shall be erected in accordance with the manufacturer's installation instructions, and shall be installed on a firm, level, fire-resistant foundation, unless listed for installation on a combustible floor, or the floor is protected by a method approved by the Chief Gas Inspector.

507.4.2 Under floor locations. When horizontal-type central furnaces are suspended in an under-floor location, they should have a clearance of not less than 6 inches vertical from the ground level. When these clearances are not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A minimum 12-inch clearance shall be provided on all sides, except the control side, which shall have a minimum of 30-inch clearance. The furnace may be installed under the floor on a concrete slab or an approved foundation rather than being suspended.

507.4.3 Protection. When excavation exceeds 12 inches or water seepage occurs at the installation location, a watertight copper pan, concrete pit or other approved material shall be used to protect the installed appliance or adequate drainage shall be provided. A copper pan shall be constructed of not less than 16 ounces per square foot of sheet copper. The pan or concrete pit shall extend not less than 4 inches above the ground level, with a minimum clearance on all sides of 6 inches, except for the control side, which shall have a 24-inch minimum clearance.

507.5 Accessibility. Central heating boilers and furnaces shall be installed to allow persons to clean heating surfaces; remove burners; replace sections, motors, controls, filters, draft hoods and other parts; and to adjust and lubricate parts as required.

507.6 Connection of flow and return pipes to boilers. The method of connecting the flow and return pipes on steam and hot water boilers shall insure a rapid circulation of steam or hot water. When designing such systems, methods used shall be in compliance with the applicable provisions of ASHRAE's *Handbook for Systems*, or the Hydronics Institute's IBR Guides 200 and 250.

507.7 Feed water and drain connections to boilers. A steam or hot water boiler shall be provided with a direct connection to a water supply through an individual control valve. A drain valve, by which the boiler shall be flushed or drained, also shall be provided.

507.8 Limit controls for boilers.

507.8.1 Automatic-limiting devices. Steam and hot water boilers, respectively, shall be provided with listed, automatic-limiting devices for shutting down the burners to prevent the boiler's steam pressure or the boiler's water temperature from exceeding the maximum allowable working pressure or temperature.

507.8.2 Steam safety or pressure relief valves. Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or pressure relief valves of an approved discharge capacity.

507.8.3 Automatic gas shut off. Steam boilers shall be provided with an automatic means to shut off the gas supply to the burners if the boiler water level drops to the lowest safe waterline.

507.8.4 Low water cut off. A hot water-heating system installed above or at the same level as radiation transfer-heating equipment shall have a low-water cutoff device installed on the boiler.

507.8.5 Limitations on controls. Safety limit controls shall not be used as operating controls.

507.9 Plenum chambers, air ducts and air duct connectors. Plenum chambers, air ducts and air duct connectors shall be designed, constructed and installed in accordance with the *EPCOT Mechanical Code*.

507.10 Return air connections. Return air connections in furnace rooms or directly below furnace rooms shall be constructed to prevent a furnace fan from drawing air from the furnace room into the return air duct.

507.11 Furnaces used with refrigeration systems and blowers. A furnace shall be installed on the discharge side of a blower, and parallel to or ahead of the refrigeration coil, unless listed for other locations. When the refrigeration coil is installed in the air discharge duct from the furnace, the blower shall be sized to supply the required amount of air through the furnace to maintain normal temperature rise, while operating against the total static pressure that exists in the system.

507.12 Insulation. Plenum chambers, air ducts, and air duct connectors shall be insulated in accordance with the *EPCOT Mechanical Code*.

507.13 Cooling units used with heating boilers.

507.13.1 Parallel piping. Boilers, when used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler.

507.13.2 Flow control valves. When hot water-heating boilers are connected to heating coils located in air-handling units, where they shall be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic devices to prevent gravity circulation of the boiler water during the cooling cycle.

507.14 Water heaters used with heating coils.

507.14.1 Maximum outlet water temperature. A water heater, when used with a heating coil, shall not have an outlet water temperature exceeding 160°F; and shall be installed in accordance with its listing, the manufacturer's installation instructions and this Code. (See Section 504.)

507.14.2 Heating coil material. Heating coils used with water heaters and located in air-handling units shall be constructed of noncorrosive materials.

507.14.3 Piping material. Piping systems, when used with water heaters and heating coils, shall be constructed of noncorrosive materials and shall comply with the requirements of the *EPCOT Plumbing Code*.

SECTION 508 AIR CONDITIONING

508.1 Connections of gas engine-powered air conditioners. To protect against the effects of normal vibration in service, gas engines shall not be rigidly connected to the gas supply piping.

508.2 Manual main shutoff valve. A manual, main shutoff valve shall be provided ahead of all controls, except the manual pilot gas valve.

508.3 Erection and mounting. An air-conditioning appliance shall be erected in accordance with the manufacturer's installation instructions. Unless the appliance is listed for installation on a combustible surface, such as a floor or roof, it shall be installed on a surface of fire-resistant construction with noncombustible material and surface finish, and with no combustible material against the underside thereof.

508.4 Cooling towers. A cooling tower used in conjunction with an air-conditioning appliance shall be installed in accordance with the manufacturer's installation instructions.

508.5 Switches in electrical supply line. Means for interrupting the electrical supply to the air-conditioning appliance and to its associated cooling tower (if supplied and installed in a location remote from the air conditioner) shall be provided within sight of, and not more than 50 feet from, the air conditioner and cooling tower.

508.6 Clearance. An air-conditioning appliance shall be installed in accordance with its listing and the manufacturer's installation instructions.

SECTION 509 VENTED WALL FURNACE

509.1 Installation.

509.1.1 General. Listed, vented wall furnaces shall be installed in accordance with their listing and the manufacturer's instructions. Listed wall furnaces shall be installed in or attached to combustible material.

509.1.2 Venting. Vented wall furnaces connected to a Type BW gas vent system, listed only for a single story, shall be installed only in single-story buildings or the top story of multistory buildings. Vented wall furnaces connected to a Type BW gas vent system listed for installation in multiple-story buildings may be installed in single-story or multiple-story buildings. Type BW gas vents shall be attached directly to a solid header plate, which serves as a firestop at that point and will be an integral part of the vented wall furnace. The stud space in which the vented wall furnace is installed shall be ventilated at the first ceiling level by installation of the ceiling plate spacers furnished with the gas vent. Firestop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent.

509.2 Location. Vented wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture or doors. Vented wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

509.3 Manual shutoff valve. A manual shutoff valve shall be installed ahead of all controls, including the pilot gas valve.

509.4 Accessibility. Vented wall furnaces shall be provided with access to clean heating surfaces; to remove burners; to replace sections, motors, controls, filters and other working parts; and to adjust and lubricate parts requiring such attention. Panels, grills and access doors that must be removed for normal servicing operations shall not be attached to the building construction.

SECTION 510 FLOOR FURNACES

510.1 Installation. Listed floor furnaces shall be installed in accordance with their listing and the manufacturer's installation instructions. Listed floor furnaces may be installed in combustible floors.

510.2 Manual shutoff valve. A separate manual shutoff valve shall be provided ahead of all controls and a union connection shall be provided downstream from this valve to permit removal of the controls or the floor furnace.

510.3 Combustion air. Fixed ventilation through a duct or grille, arranged to supply air from a permanently ventilated attic or under-floor space, shall be provided to any confined space that encloses the floor furnace. The duct or grille shall be screened, having a free area of not less than 1 square inch per 1,000 Btu/h of gas input, and shall be installed to ensure proper combustion.

510.4 Placement. The following are requirements that will serve in placing the furnace to serve one story:

- (a) No floor furnace shall be installed in the floor of any aisle, or passageway of any auditorium, public hall or place of assembly, or in any exitway from any such room or space.
- (b) With the exception of wall-register models, a floor furnace shall not be placed closer than 6 inches to the nearest wall, and wall-register models shall not be placed closer than 6 inches to a corner.
- (c) The furnace shall be so placed that a drapery or similar object cannot be nearer than 12 inches to any portion of the register of the furnace. Floor furnaces shall not be installed in concrete floor construction built on grade. Doors that can be closed shall not be permitted between the floor furnace location and the controlling thermostat, nor shall any floor furnace be installed in such a manner that will permit any door to swing over it.

510.5 Bracing. The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists.

510.6 Support. Means shall be provided to support the furnace when the floor grille is removed.

510.7 Clearance. The lowest portion of the floor furnace shall have a 6-inch-minimum clearance from the general ground level, except that where the lower 6-inch portion of the floor furnace is sealed by the manufacturer to prevent the entrance of water, the minimum clearance shall be not less than 2 inches. When these clearances are not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A 12-inch clearance shall be provided on all sides, except the control side, which shall have an 18-inch clearance.

510.8 Seepage pan. When excavation exceeds 12 inches, or water seepage is likely, unless adequate drainage is provided, a water-tight copper pan, concrete pit, or other approved material shall be used. A copper pan shall be made of not less than 16 ounces per square foot of sheet copper. The pan shall be anchored in place so as to prevent floating. The walls of the pan or concrete pit shall extend not less than 4 inches above ground level, with a 6-inch clearance on all sides, except for the control side, which shall have an 18-inch clearance. When the equipment is sealed by the manufacturer to meet this provision, the pan or pit may be omitted if not required to maintain a dry condition for service access.

510.9 Access. Provisions shall be made to access to the floor furnace by means of an opening in the foundation wall that is not less than 22 inches by 30 inches; or through a trap door that is not less than 22 inches by 30 inches, located in an approved location with not less than a 30-inch-high by 22-inch-wide unobstructed passageway to the floor furnace.

510.10 Wind protection. Floor furnaces shall be protected, where necessary, against high-wind conditions.

SECTION 511 DUCT FURNACES

511.1 Clearance. Listed gas-fired duct furnaces shall be installed with 6-inch-minimum clearances between the adjacent walls, ceilings and floors of combustible construction, and the appliance's projecting draft hood, except that duct furnaces listed for installation at a lesser clearance may be installed in accordance with their listing. In no case shall the clearance be such as to interfere with the requirements for combustion air and accessibility. (See Subsections 402.4 and 511.4.)

511.2 Erection, connection and controls of appliances. A duct furnace shall be erected and supported in accordance with the manufacturer's installation instructions, and shall be installed on the discharge side of the blower.

511.3 Accessibility. The installation of duct furnaces shall be such as to make them accessible for cleaning the heating surfaces, removal of filters or burners, replacement of sections, controls, draft hoods and other working parts, and for adjustment of parts requiring such attention.

511.4 Access panels. The ducts connected to duct furnaces shall have removable access panels on both upstream and downstream sides of the furnace.

511.5 Location of draft hoods and controls. The controls and draft hoods for duct furnaces shall be located outside the ducts. The draft hood shall be located in the same enclosure from which combustion air is taken.

511.6 Circulating air. Circulating air heated by the furnace shall not be taken from the same enclosure in which the furnace is located.

511.7 Duct furnaces used with refrigerating systems and blowers. The duct furnace shall be installed on the discharge side of the blower. The duct furnace shall be installed parallel with or ahead of the refrigerating coil unless listed for other locations. If the refrigerating coil is installed in the air discharge duct from the duct furnace, the system blower shall be of a size and capacity to supply the required amount of air through the duct furnace to maintain a normal temperature rise, while operating against the total static pressure in the system.

511.8 Installation and insulation. All flexible duct connections shall be made with fire-resistant materials. All ductwork exposed in unheated attic or crawl spaces shall be insulated to provide a thermal resistance, excluding film resistances, of

$$R = \frac{3t}{15}$$

where:

3_t = The design temperature differential between the air in the duct and the minimum winter design temperature.

$$R = h \cdot \text{ft}^2 \cdot ^\circ\text{F/Btu.}$$

511.9 Manual shutoff valves.

511.9.1 Complete shutoff safety device is not used. When a complete shutoff-type safety device is not utilized, a manual shutoff valve shall be provided ahead of all controls, except the manual pilot gas valve.

511.9.2 Complete shutoff safety device is used. Where a complete shutoff safety device is utilized, a manual shutoff valve shall be provided for shutting off the main burner gas independently of the pilot gas.

511.9.3 Union connection location. A union connection shall be provided downstream from the manual shutoff valve to permit the removal of controls, including the safety shutoff device.

SECTION 512 CONVERSION BURNERS

512.1 General. Installation of conversion burners shall conform to ANSI Z21.8, except that a low-water cutoff shall be provided on steam boilers.

SECTION 513 UNIT HEATERS

513.1 Support. Suspended-type, gas-fired unit heaters shall be supported by elements that are designed and constructed to accommodate the weight and dynamic load. Hangers and brackets shall be of noncombustible material.

513.2 Clearance. Listed gas-fired unit heaters shall be installed with 6-inch-minimum clearances between the appliance, projecting flue box or draft hood, and combustible construction. The control side of a unit heater shall be spaced not less than 18 inches from any wall or partition.

513.3 Ductwork. A unit heater shall not be attached to a warm air duct system, unless listed for such installation.

513.4 Garage and aircraft hangars.

513.4.1 Garage installations. Unit heaters installed in garages for more than three motor vehicles shall be not less than 8 feet above the floor.

513.4.2 Aircraft hangar installations. Unit heaters installed in aircraft hangars shall be not less than 10 feet above the upper surface of wings and engine enclosures of the highest aircraft that shall be housed in the hangar. Heaters shall be listed in accordance with Section 407. Heaters shall be located so that they will not be subject to damage by

aircraft, cranes, scaffolding or other movable equipment. Provisions shall be made to ensure accessibility to suspended heaters for recurrent maintenance purposes.

513.5 Manual shutoff valves. A separate manual shutoff valve shall be provided ahead of all controls. A union connection shall be provided downstream from this valve to permit the removal of controls.

SECTION 514 DIRECT GAS-FIRED MAKEUP AIR HEATERS

514.1 Application.

514.1.1 General. Listed, direct gas-fired, makeup air heaters complying with ANSI Z83.4 shall be used only for heating incoming outside air for the purpose of replacing air exhausted from the space and ventilating the space.

514.1.2 Limitations. Such heaters shall be for industrial or commercial occupancies, and shall be installed in accordance with their listing and the manufacturer's installation instructions.

514.2 Location. The fresh air intake for a direct gas-fired, makeup air heater shall be located so that contaminated air will not be drawn in from exhaust stacks.

514.3 Accessibility. The installation of direct gas-fired, makeup air heaters shall make them accessible for removal of burners; the replacement of motors, controls, filters and other working parts; and for adjustment and lubrication of parts requiring such attention.

514.4 Combustion and makeup air supply. All air handled by the equipment, including combustion air, must be brought from outside. Inside air may be added to the outside airstream after the stream has passed the combustion zone.

514.5 Atmospheric vents and gas relief or bleeds.

514.5.1 Outside discharge required. Valve train components requiring atmospheric air pressure to balance a diaphragm, such as a gas-pressure regulator or gas-pressure switch, shall have their atmospheric vent lines and gas reliefs, or bleeds, led to an approved location outside the building with piping or tubing.

514.5.2 Protected lines. Means shall be employed on vent lines and bleeds to prevent water from entering, and to prevent stoppage by insects and foreign matter.

514.5.3 Vent lines not required. Vent lines need not be provided on components equipped with recognized vent-limiting devices.

514.6 Control system. If outside air-closing louvers or dampers of either the manual or automatic type are used, they shall be automatically verified to be in the full-open position before the equipment blowers and main burners can operate.

514.7 Relief openings.

514.7.1 Design. The design of the installation of a direct gas-fired, makeup air heater shall include provisions to permit the equipment to operate at rated capacity by taking into account the structure's designed infiltration rate, providing properly designed relief openings or providing an inter-

locked power exhaust system, or a combination of these methods.

514.7.2 Approved methods. The designed infiltration rate and the size of any relief openings shall be determined by approved engineering methods.

514.7.3 Openings. Relief openings may be louvers or counterbalanced gravity dampers; or, if motorized dampers, they shall be interlocked so as not to permit equipment blower and main burner operation until they are automatically verified to be in the full-open position.

SECTION 515 DIRECT GAS-FIRED INDUSTRIAL AIR HEATERS

515.1 Application.

515.1.1 General. Listed, direct gas-fired, industrial air heaters shall comply with ANSI Z83.18 and be used to offset building heat loss.

515.1.2 Limitations. Such heaters shall be for industrial or commercial occupancies, and shall be installed in accordance with their listing and the manufacturer's installation instructions.

515.2 Location. The fresh air intake for a direct gas-fired, industrial air heater shall be located so that contaminated air will not be drawn in from exhaust stacks.

515.3 Accessibility. The installation of direct gas-fired, industrial air heaters shall make them accessible for the removal of burners; the replacement of motors, controls, filters and other working parts; and for the adjustment and lubrication of parts requiring such attention.

515.4 Air supply.

515.4.1 Source of air. Air to the equipment shall be taken from the building, ducted directly from outdoors or a combination of both.

515.4.2 Ventilation rate. Unless the equipment incorporates a means to supply ventilation air, outside ventilation air shall be provided to supply at least 4 cubic feet per minute (cfm) per 1,000 Btu/h of rated input. If a separate mechanical means is used, an interlock shall be provided so as not to permit main burner operation until the mechanical means is automatically verified.

515.4.3 Prohibited installations. Recirculating, direct-fired, industrial air heaters shall not be installed in hazardous locations, or buildings that contain flammable solids, liquids and gases; explosive materials (e.g., grain dust, coal dust, gun powder); and substances that may become toxic when exposed to heat (e.g., refrigerants, aerosols). Recirculation is not recommended in uninsulated buildings in areas where outside temperatures fall below 32°F.

515.5 Atmospheric vents and gas relief or bleeds.

515.5.1 Outside discharge required. Valve train components requiring atmospheric air pressure to balance a diaphragm, such as a gas-pressure regulator or gas-pressure switch, shall have their atmospheric vent lines and gas reliefs, or bleeds, led to an approved location outside the building with piping or tubing.

515.5.2 Protected lines. Means shall be employed on vent lines and bleeds to prevent water from entering, and to prevent stoppage by insects and foreign matter.

515.5.3 Vent lines not required. Vent lines need not be provided on components equipped with recognized vent-limiting devices.

515.6 Control system. If outside air-closing louvers or dampers of either the manual or automatic type are used, they shall be automatically verified to be in the full-open position before the equipment blowers and main burners can operate.

515.7 Relief openings.

515.7.1 Design. The design of the installation of a direct gas-fired, industrial air heater shall include provisions to permit the equipment to operate at rated capacity taking into account the structure's designed infiltration rate, providing properly designed relief openings or providing an interlocked power exhaust system, or a combination of these methods.

515.7.2 Approved methods. The designed infiltration rate and the size of any relief openings shall be determined by approved engineering methods.

515.7.3 Openings. Relief openings may be louvers or counterbalanced gravity dampers; or, if motorized dampers, they shall be interlocked so as not to permit the equipment blower and main burner operation until they are automatically verified to be in the full-open position.

SECTION 516 INFRARED RADIANT HEATERS

516.1 Support. Infrared radiant heaters shall be safely and adequately fixed in position independent of gas and electric supply lines. Hangers and brackets shall be noncombustible material.

516.2 Clearances. Listed infrared radiant heaters shall be installed with clearances from combustible material of not less than those shown on the marking plate and in accordance with the manufacturer's installation instructions.

SECTION 517 CLOTHES DRYERS

517.1 Clearance.

517.1.1 Domestic clothes dryers. Listed, Type 1 clothes dryers shall be installed with minimum clearance of 6 inches from adjacent combustible construction, except that clothes dryers listed for installation at lesser clearances may be installed in accordance with their listing. Moisture exhaust ducts, when used, shall be installed in accordance with the manufacturer's installation instructions.

517.1.2 Exhaust installation. When a listed, Type I clothes dryer is installed within the living areas of a home, provisions shall be made for exhausting the extracted moisture to the outside atmosphere.

517.1.3 Commercial clothes dryers. Listed, Type 2 clothes dryers shall be installed with clearance not less than those shown on the marking plate and in accordance

with the manufacturer's installation instructions. Type 2 clothes dryers designed and marked "For use only in fire-resistant locations" shall not be installed elsewhere.

517.1.4 Makeup air. Air supply to clothes dryers shall be in accordance with Subsection 402.4 when the installation is made in small rooms, bathrooms or other confined spaces, and provisions shall be made for exhausting the appliance to the outside of the building.

517.1.5 Vent connections. A vent from a dryer shall not connect to any natural draft vent that is in use for other fuel-burning appliances.

517.2 Public use. Clothes dryers installed for multiple-family use shall be equipped with listed safety shutoff devices.

SECTION 518 INCINERATORS

518.1 Clearance. Listed, gas-fired incinerators shall be installed as close as practicable to a vent and with a minimum 12-inch clearance between the sides and combustible construction, except that appliances approved for installation at lesser clearances may be installed in accordance with their listing. The clearance shall not in any case be such as to interfere with the requirements for combustion air in Subsection 402.4 and accessibility in Subsection 402.8. Wall-type incinerators shall be installed in a noncombustible wall connecting directly with a chimney flue.

518.2 Vent connectors. A draft hood shall not be connected to the vent connector of an incinerator.

518.3 Vent connector clearance. Vent connectors shall have an 18-inch-minimum clearance from combustible construction, and shall not pass through combustible construction unless guarded at the point of passage as specified in Subsection 607.8.

518.4 Vent connector material. The vent connector from an incinerator to a vent shall be a minimum of 0.0276-inch-thick galvanized steel or of a material having equivalent or superior heat- and corrosion-resistant properties. Joints shall be secured by sheet metal screws.

SECTION 519 REFRIGERATORS

519.1 General. Gas refrigerators shall be provided with adequate clearances for ventilation at the top and back. They shall be installed in accordance with the manufacturer's installation instructions. If such instructions are not available, a 2-inch-minimum clearance shall be provided between the back of the refrigerator and the wall, and at least 12 inches above the top.

SECTION 520 HOT PLATES AND LAUNDRY STOVES

520.1 General. Listed, domestic hot plates and laundry stoves, when installed on combustible surfaces, shall be set on their own legs or bases. They shall be installed with minimum horizontal clearances of 6 inches from combustible construction. The vertical distance between the tops of all

domestic hot plates and laundry stoves and combustible material shall be a minimum of 30 inches.

SECTION 521 HOTEL AND RESTAURANT COOKING EQUIPMENT

521.1 General. These appliances shall be installed in accordance with the terms of their listing. Rather than utilizing the provisions of Chapter 6, approved kitchen ventilation or venting facilities may be employed.

SECTION 522 ILLUMINATING APPLIANCES

522.1 General. Listed illuminating appliances shall be installed in accordance with their listings and the manufacturer's installation instructions.

522.2 Mounting on buildings. Illuminating appliances designed for wall or ceiling mounting shall be securely attached to substantial structures in such a manner that they are not dependent on the gas piping for support.

522.3 Mounting posts. Illuminating appliances designed for post mounting shall be securely and rigidly attached to a post.

SECTION 523 SAUNA HEATERS

523.1 Location and protection.

523.1.1 Accidental contact. A sauna heater shall be so located as to minimize the possibility of accidental contact by a person in the room.

523.1.2 Guard or barrier. A sauna heater shall be protected from accidental contact by a guard or barrier of material having a low coefficient of thermal conductivity. Wood is satisfactory for this application. The guard shall have no substantial effect on the transfer of heat from the heater to the room.

523.2 Installation of heater.

523.2.1 General. A listed sauna heater shall be installed in accordance with its listing and the manufacturer's installation instructions.

523.2.2 Direct-vent heaters. A direct-vent sauna heater shall be installed with the vent/air intake terminating in the outside atmosphere. The thickness of the wall on which the heater is mounted shall be within the range of wall thicknesses marked on the heater and as required by the manufacturer's installation instructions.

523.2.3 Panels, grilles and access doors. Panels, grilles and access doors that must be removed for required servicing operations, shall not be attached to the building.

523.2.4 Vented heaters. A sauna heater of other than the direct-vent type shall be installed with the draft hood and combustion air intake located outside the sauna room. If the combustion air inlet and the draft hood are in a dressing room adjacent to the sauna room, there shall be provisions

to prevent the blocking of the combustion air inlet and the draft hood inlet, and to prevent physical contact with the draft hood and vent assembly; or warning notices shall be posted to avoid such contact. Any warning notice shall contrast with its background and the wording shall be in letters not less than 1/4 inch high.

523.3 Connection. The provisions of Section 403 shall be required, except that when access to controls is from an adjacent room, connections shall be made in that area.

523.4 Combustion and ventilation air.

523.4.1 Source requirement. Combustion air shall not be taken from inside the sauna room.

523.4.2 Location. Approved combustion and ventilation air for a heater not of the direct-vent type shall be provided to the area in which the combustion air inlet and draft hood are located in accordance with Subsection 402.4.4.2.

523.5 Heat and time controls.

523.5.1 Limitations and location. A sauna heater shall be equipped with a thermostat that will limit the room temperature to 194°F. If the thermostat is not an integral part of the heater, the heat-sensing element shall be located within 6 inches of the ceiling. If the heat-sensing element is a capillary tube and bulb, the assembly shall be attached to the wall or other support, and shall be protected against physical damage.

523.5.2 Maximum operating time. A timer, if provided to control main burner operation, shall have a maximum operating time of 1 hour. The control for the timer shall be located outside the sauna room.

523.6 Sauna room.

523.6.1 Ventilation opening. A ventilation opening into the sauna room shall be provided. This shall be not less than a 4-inch by 8-inch opening near the top of the door into the sauna room.

523.6.2 Warning sign. The following notice on permanent marking material shall be mechanically attached to the sauna room on the outside:

WARNING: DO NOT EXCEED
30 MINUTES IN SAUNA.

EXCESSIVE EXPOSURE CAN BE
HARMFUL TO HEALTH.

ANY PERSON WITH POOR
HEALTH SHOULD CONSULT
A PHYSICIAN BEFORE USING SAUNA.

This marking shall contrast with its background and the wording shall be in letters not less than 1/4 inch high.

SECTION 524 STATIONARY GAS ENGINES AND GAS TURBINES

524.1 Powered equipment. The installation of gas engines and gas turbines shall comply with NFPA 37.

SECTION 525 POOL HEATERS

525.1 General. Pool heater installations shall conform to this Code and the *EPCOT Energy Efficiency Code for Building Construction*.

SECTION 526 GAS-FIRED TOILETS

526.1 Clearance. A listed, gas-fired toilet shall be installed in accordance with its listing and the manufacturer's installation instructions, provided that the clearance shall, in any case, be sufficient to afford ready accessibility for use, cleanout and required servicing.

526.2 Mounting. Listed, gas-fired toilets specifically listed for installation on combustible floors may be so installed.

526.3 Installation. Vents or vent connectors shall be protected or blocked to prevent contact when such equipment is located in a room in which a toilet is installed.

SECTION 527 OUTDOOR COOKING APPLIANCES

527.1 General. Outdoor cooking appliances shall be installed in accordance with their listing and the manufacturer's installation instructions.

SECTION 528 GAS-FIRED LOGS

528.1 General. Gas-fired logs shall be installed in accordance with their listing and the manufacturer's installation instructions.

528.2 Damper stop. Gas-fired logs shall be installed with a damper stop to prevent the damper from accidentally being closed when logs are in use. Provisions shall be made for accessibility, and for the combustion and ventilation air supply.

SECTION 529 COMPRESSED NATURAL GAS (CNG) VEHICULAR FUEL SYSTEMS

529.1 General. The installation of CNG fuel-dispensing systems shall comply with NFPA 52.

SECTION 530 GENERATORS

530.1 Gas supply. Where the gas supply is connected to the building gas supply system, it shall be connected on the supply side of the main gas shutoff valve and marked as supplying an emergency generator.

530.2 Main shutoff valve. The building's main gas shutoff valve shall be marked or tagged to indicate the existence of the separate generator shutoff valve.

530.3 Demands. The fuel supply for gas-fueled and liquid-fueled generators shall be designed to meet the demands of the generator for all of the following factors:

- (a) Sizing of fuel lines
- (b) Valves, including manual shutoff
- (c) Battery-powered fuel solenoids
- (d) Gas regulators
- (e) Regulator vent piping
- (f) Flexible fuel line section
- (g) Fuel line filters
- (h) Fuel vaporizers (LP-gas)
- (i) Ambient temperature effect of fuel tank vaporization rates of LP-gas where applicable

530.4 Fuel storage and supply lines. The fuel storage and supply lines shall be in accordance with this Code.

530.5 Valves. All manual fuel system valves shall be of the indicating type.

CHAPTER 6

VENTING OF APPLIANCES

SECTION 601 GENERAL

601.1 Responsibility. This Chapter provides the fundamental requirements of venting gas appliances. The installing agency shall be responsible for complying with these requirements.

601.2 Listing. Listed, sealed combustion system appliances, gas vents, factory-built chimneys and gas vent connectors shall be installed according to their listing.

SECTION 602 APPLICABLE APPLIANCES

602.1 Appliances requiring vents. The following types of appliances shall be connected to vents or other approved devices for exhausting flue gases to the outside atmosphere.

- (a) Steam and hot water boilers, warm-air furnaces, floor furnaces, unit heaters, duct furnaces and vented wall furnaces.
- (b) Incinerators.
- (c) Water heaters, with inputs greater than 5,000 Btu/h, except as required by Subsections 602.2(h) and 602.2(i).
- (d) Room heaters listed for vented use only.
- (e) Type 2 clothes dryer.
- (f) Appliances equipped with gas conversion burners.
- (g) Appliances listed for vented use only.

602.2 Appliances not requiring vents. Any appliance included in the following list for vented use or having installation limitations shall be installed in accordance with its listing or installation limitations.

- (a) Ranges.
- (b) Refrigerators.
- (c) Counter appliances.
- (d) Type 1 clothes dryers.
- (e) Appliances listed for unvented use.
- (f) Specialized equipment of limited input such as laboratory burners or gas lights.
- (g) Room heaters or appliances listed for unvented use, installed in the same room that, if not vented, would make the total input rating of the unvented appliances less than 30 Btu/h/ft³ of room content. When the room or space in which the equipment is installed is directly connected to another room or space by a doorway, archway or other opening of comparable size that cannot be closed, the volume of such adjacent room or space shall be included in the calculation. (See Subsections 505.3, 505.4, 505.5 and 505.6 for prohibited installations.)
- (h) Domestic dishwashers with built-in water heater boosters.

- (i) A single, listed, booster-type (automatic instantaneous) water heater when designed and used solely for the sanitizing rinse requirements of a National Sanitation Foundation (NSF) Class 1, 2 or 3 dishwashing machine, provided that the input is limited to 50,000 Btu/h, the storage capacity is limited to 12½ gallons, and the heater is installed, with the draft hood in place and unaltered, in a commercial kitchen having a mechanical exhaust system. When installed as required, the draft hood outlet shall be not less than 36 inches vertically and 6 inches horizontally from any surface other than the heater.

SECTION 603 MINIMUM SAFE PERFORMANCE

603.1 Positive flow. Venting systems shall be engineered and constructed so as to maintain a positive flow as required to exhaust flue gases to the outside atmosphere.

603.2 Adequate draft. Venting systems serving appliances that require draft for proper operation of the system shall be designed and installed to meet the draft requirements of the appliance in accordance with the manufacturer's installation instructions.

603.3 Vent connection. Gas appliances required to be vented shall be connected to vents designed and constructed in accordance with the provisions of this Code.

603.4 Duct and plenum penetration. Portions of vent systems shall not extend into or pass through any circulation air duct or plenum.

SECTION 604 DRAFT HOODS

604.1 General. Every appliance listed for vented use, except incinerators, dual oven-type combination ranges, direct-vent appliances, and units designed for power burners or for forced venting, shall have a draft hood.

604.2 Installation of draft hood. Where the draft hood is a part of the appliance or is supplied by the appliance manufacturer, it shall be installed without alteration in accordance with the manufacturer's installation instructions. In the absence of manufacturer's installation instructions, the draft hood shall be attached to the flue collar of the appliance or as near to the appliance as conditions permit. A draft hood shall not, in any case, be installed in a false ceiling, in a different room, or in any manner that will permit a difference in pressure between the draft hood relief opening and the combustion air supply.

604.3 Position of draft hood. A draft hood shall be installed in the position for which it was designed with reference to the horizontal and vertical planes, and shall be located so that the

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relief opening is not obstructed by any part of the appliance or adjacent construction.

604.4 Special draft hoods. Where the installer must supply a draft hood of special design, see ANSI Z21.12.

604.5 Clearance of draft hoods. Minimum clearance between a draft hood and combustible construction shall comply with the provisions of Tables 604.5A and 604.5B.

**TABLE 604.5A
DRAFT HOOD AND VENT CONNECTOR CLEARANCE FOR
LISTED APPLIANCES, UNLESS OTHERWISE MARKED**

APPLIANCE	MINIMUM DISTANCE FROM COMBUSTIBLE CONSTRUCTION (inches)			
	Draft hood	Single-wall metal vent connectors	Type B vent connectors	Type L vent connectors
Boiler	6	6	As listed	As listed
Warm-air furnace	6	6	As listed	As listed
Water heater	6	6	As listed	As listed
Room heater	2	6	As listed	As listed
Floor furnace	—	6	As listed	As listed
Incinerator	Not permitted	18	not permitted	9
Boilers and furnaces with listed gas conversion burner and draft hood	9	9	6	6
Appliances listed for use with Type L venting systems	9	9	Not permitted	As listed

Notes:

1. The clearance from metal vent connectors to combustible construction shall be reduced as specified in Table 604.5B where the combustible construction is protected in accordance with this Table.
2. Clearances to combustible materials for connectors used with condensing furnaces or boilers shall be in accordance with their listing or the manufacturer's installation instructions.

**TABLE 604.5B
REDUCED CLEARANCES WITH SPECIFIED PROTECTION**

PROTECTION	WHERE REQUIRED CLEARANCE WITH NO PROTECTION (inches)		
	6	9	18
28 gage sheet metal spaced out 1 inch with noncombustible spacers	2	4	9

SECTION 605 TYPES OF VENTS

605.1 Masonry and metal chimneys. Masonry and metal chimneys may be employed for venting gas appliances in accordance with the manufacturer's installation instructions and the terms of the listing.

605.2 Factory-built chimneys. Listed prefabricated chimneys may be employed in accordance with their listing for venting the following types of appliances in accordance with the manufacturer's installation instructions and the terms of the listing:

- (a) Domestic incinerators.

- (b) Gas appliances.

- (c) Combination gas-oil appliances.

605.3 Type B, BW and L gas vents.

605.3.1 Type B. Type B gas vents shall be used (in accordance with the manufacturer's installation instructions and the terms of listing) only with listed gas appliances that produce flue gas temperatures not in excess of 550°F at the inlet of the draft hood when burning gas at the manufacturer's recommended input rating. For the purpose of this provision, listed appliances with draft hoods may be accepted as producing flue gas temperatures not in excess of 550°F at the inlet of the draft hood.

605.3.2 Type BW. Type BW gas vents shall be used in the venting of wall furnaces when installed within combustible 2 by 4 wall construction as prescribed in Subsection 509.1.

605.3.3 Type L. Type L venting systems may be used to vent the following appliances in accordance with the appliance manufacturer's installation instructions and the terms of listing:

- (a) All listed gas appliances with draft hoods.
- (b) All gas appliances listed for use with Type B gas vents.
- (c) All appliances listed for use with Type L venting systems.

605.4 Single-wall metal gas vents.

605.4.1 Limitations of use. Single-wall vents shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air. Such vents shall not be installed in any attic or concealed space, nor through any floor. Installations with reference to clearances to combustible construction and passage through walls or roofs shall comply with the provisions of Subsections 607.8 and 607.9.

605.4.2 Incinerator venting. Single-wall, metal vents shall be used for venting incinerators used outdoors, such as in open sheds, breezeways and carports. In such cases, the vent shall be exposed, readily examinable for its full length and required clearances shall be maintained.

605.5 Plastic pipe. Approved plastic pipe may be used for venting condensing-type furnaces and boilers in accordance with the manufacturer's installation instructions.

SECTION 606 LISTING

606.1 General. Factory-built chimneys, Type B, BW and L gas vents shall be installed in accordance with their listing and the manufacturer's installation instructions. When so listed, these gas vents may be used for single- or multiple-story installations, and may be connected to appliances on one or more floors. A Type BW vent shall have a listed capacity not less than that of the listed, vented wall furnace to which it is connected.

SECTION 607 VENT CONNECTORS

607.1 Materials.

607.1.1 General. The materials used for the vent connector shall be resistant to corrosion and be of sufficient thickness to withstand damage.

607.1.2 Attic installations. Vent connectors for appliances installed in attics shall be of Type B or L vent material.

607.1.3 Type of connectors allowed. Vent connectors serving listed gas appliances with draft hoods and other appliances listed for use with Type B vents may be constructed of Type B gas vent material. Vent connectors made of Type L venting system material may be used with gas or combination gas-oil fuel-burning residential appliances, including residential-type incinerators.

607.1.4 Corrosion and heat resistance. Single-wall vent connectors used for gas appliances having draft hoods, and for gas appliances having draft hoods and equipped with listed conversion burners that are not installed in attics, shall be constructed of materials having a resistance to corrosion and heat not less than that of 0.0187-inch galvanized sheet steel.

607.2 Bends. The vent connectors shall be installed so as to avoid short turns or other constructional features that would create excessive resistance to the flow of flue gases.

607.3 Pitch. The vent connectors shall maintain a pitch or rise from the appliance to the vent. A rise of not less than $\frac{1}{4}$ inch per foot of horizontal length shall be maintained. The vent connector shall be free from any dips or sags.

607.4 Vertical run. Wherever sufficient headroom is available, appliances having a horizontal flue outlet shall be provided with a vertical run of vent connector before installing the horizontal length. To minimize frictional resistance in the vent connector, it is recommended that 45-degree elbows be used.

607.5 Length. The horizontal run of the vent connector shall be maintained at a minimum length. The maximum length of a single-wall metal vent connector venting one appliance shall not exceed three-fourths of the height of the gas vent. The maximum length of a Type B or L double-wall vent connector, venting one appliance, shall not exceed 100 percent of the total height of the vent. When greater lengths of connectors are required, they shall be constructed in accordance with approved engineering methods.

607.6 Support. Vent connectors shall be supported for the design and weight of the material employed to maintain clearances, and prevent physical damage and separation of joints.

607.7 Joints. Every joint of vent pipe shall be securely fastened in position, either by supporting hangers or brackets, with each joint of metal pipe permanently secured together with metal screws, rivets or ratchet nails, or by other means acceptable to the Chief Gas Inspector.

607.8 Clearance. Vent connectors shall be located in such a manner that continued operation of the appliance will not

raise the temperature of the surrounding combustible construction more than 90°F above normal room temperature. Minimum clearances from combustible construction to vent connectors for listed appliances are shown in Tables 604.5A and 604.5B.

607.9 Use of thimbles.

607.9.1 Clearance. When passing through combustible walls or partitions, vent connectors of listed gas-vent material shall be installed so that the clearances required by the listing are maintained.

607.9.2 Single-wall connector penetrations of combustible walls. Single-wall, metal vent connectors shall not pass through any combustible walls, unless they are protected at the point of passage by ventilated metal thimbles not smaller than the following:

- (a) For listed appliances, except incinerators, 4 inches greater in diameter than the vent connector, unless there is a run of not less than 6 feet of vent connector in the open, between the draft hood outlet and the thimble, in which case the thimble may be 2 inches larger in diameter than the vent connector.
- (b) For incinerators, 12 inches larger in diameter than the vent connector.

607.10 Size.

607.10.1 General. The vent connector shall not be smaller than the size of the flue collar or the size of the outlet of the draft hood supplied by the manufacturer of a gas-designed appliance. Where the appliance has more than one flue outlet, and in the absence of the manufacturer's installation instructions, the vent connector shall equal the combined area of the flue outlets for which it acts as a common connector to the vent.

607.10.2 Branch connections. Branch connections of the vent connector shall be made in accordance with the vent manufacturer's installation instructions or as approved by the Chief Gas Inspector. Section 611 provides a method of sizing vent connectors.

607.11 Manually operated dampers.

607.11.1 General. Manually operated dampers shall not be placed in the vent connector from a gas appliance, except as required by Subsections 607.11.2 and 607.11.3. Fixed baffles ahead of draft hoods are not classified as dampers.

607.11.2 Manufacturer's requirements. A manually operated damper or automatic draft regulator may be installed in the vent connector of a listed gas incinerator only when recommended by the manufacturer. Such a damper or draft regulator shall be installed in accordance with the manufacturer's installation instructions.

607.11.3 Damper stop. A damper stop shall be provided on dampers when gas logs are installed in fireplaces to prevent the damper from closing by accident.

607.12 Automatically operated dampers. A listed automatic vent damper may be installed on an existing appliance installation, provided the appliance is listed and equipped with a draft hood, and provided the device is installed by an

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approved agency in accordance with the terms of its listing. The name of the installer and date of installation shall be marked on a label affixed to the damper.

607.13 Fireplace. A vent connector shall not be connected to a chimney flue having a fireplace opening, unless the opening is permanently sealed.

607.14 Vent connectors serving two or more appliances.

607.14.1 Installation. When two or more vent connectors enter a common gas vent or chimney, the smaller connector shall enter at the highest level consistent with available headroom or clearance to combustible material.

607.14.2 Location. Two or more gas appliances may be vented through a common vent connector or manifold located at the highest level consistent with available headroom or clearance to combustible material.

607.14.3 Sizing. The manifold, all junction fittings and the common-vent connector serving two or more appliances shall be of a size adequate for the combined volume of vent gases.

607.15 Location. When the vent connector used for an appliance having a draft hood must be located in or pass through a crawl space or other area difficult for access that may be cold, that portion of the vent connector shall be of listed double-wall, Type B, gas-vent material, or of material having equivalent insulation qualities. Single-wall metal pipe used as a vent connector shall not pass through any floor or ceiling. Vent connectors shall not connect to a chimney in an attic. Type B, listed, double-wall vents and vent connectors in an attic shall be installed in accordance with their listing.

SECTION 608 VENTS

608.1 General.

608.1.1 Category I appliances. This section applies only to venting for Category I appliances (See Chapter 2 for the definitions of "Vented appliance categories.") Category II, III or IV appliances, such as forced draft or exhaust systems, and power burners, usually require special engineering and installation, and should be approved by the Chief Gas Inspector.

608.1.2 Inspection required. Prior to connecting a vent connector, the vent shall be inspected to ensure that it is clear of obstructions and will conduct the products of combustion to the outside air.

608.2 Size.

608.2.1 Alternative sizing. Vents shall be sized and constructed in accordance with approved engineering methods. A method of sizing Category I appliance vents is provided in Section 611. As an alternative method for sizing an individual vent for a single, draft-hood-equipped appliance only, the effective area of the vent connector and vent shall be not less than the area of the appliance draft hood outlet. As an alternative method for sizing a vent connected to more than one draft-hood-equipped appliance, the effective area of the vent shall be not less than the area of the largest vent connector in addition to 50 percent of the areas of additional

draft hood outlets. The area shall not, in any case, be less than the area of 3-inch-diameter pipe.

608.2.2 Elliptical or rectangular vents. An elliptical or rectangular vent may be used, provided its flue gas venting capacity, as determined from manufacturer's capacity tables, is equal to the capacity of round pipe for which it is substituted.

608.2.3 Incinerator venting. When an incinerator is vented by a chimney serving other gas appliances, the gas input to the incinerator need not be included in calculating the chimney size, provided the chimney diameter is not less than 1 inch larger in equivalent diameter than the diameter of the incinerator flue outlet.

608.3 Gas vent termination.

608.3.1 Roof terminations. Gas vents shall extend at least 2 feet above the highest point where they pass through the roof of a building and at least 2 feet higher than any portion of the building within 10 feet, except that gas vents need not comply with this provision when a vent cap, which ensures proper venting, is attached to, and terminates the vent above, the roof. Such vent cap shall be listed or approved by a nationally recognized testing agency, and shall be installed according to the listing or approved requirements.

608.3.2 Weather-resistant flashing. Vents that extend through roofs of houses and buildings shall have a weather-resistant flashing.

608.3.3 Height above the highest connected appliance draft hood or flue collar. Vents shall not terminate less than 5 feet in vertical height above the highest connected appliance draft hood outlet or flue collar.

Exception: Venting systems of direct-vent appliances.

608.3.4 Type BW vent terminations. Type BW gas vents serving a vented wall furnace shall terminate not less than 12 feet vertically above the bottom of the furnace.

608.4 Chimney entrance. When entering a chimney, the connection shall be above the extreme bottom to avoid stoppage. Means shall be employed that will prevent the vent connector from entering so far as to unduly restrict the space between its end and the opposite wall of the chimney. A thimble or slip joint may be used to facilitate the removal of the vent connector for cleaning.

608.5 Cleanouts. Cleanouts shall be of such construction that they will remain tightly closed when not in use.

608.6 Venting into vent used for other fuels.

608.6.1 Solid fuel-burning appliances. A gas appliance shall not be connected to a vent serving a separate appliance designed to burn solid fuel.

608.6.2 Liquid fuel-burning appliances. A gas appliance automatically controlled may be connected through separate openings to a vent that also serves equipment for the combustion of liquid fuel; or may be connected through a single opening if joined as close as practical to the vent. If two or more openings are provided into one vent, they should be at different levels.

608.7 Vent connecting two or more appliances. In order to promote better draft, where more than one gas appliance vent connector is connected to a vent, the connections shall be made at different levels. Two or more gas appliances shall be vented through a common vent connector when necessary, if joined as close as practical to the vent, and provided the size of the common vent is sufficient to accommodate the total volume of flue gases. All transitions shall be in accordance with the manufacturer's installation instructions or as approved by the Chief Gas Inspector.

608.8 Unlined chimneys. Where an existing chimney is unlined or where local experience indicates that flue gas condensate might be a problem, consult the Chief Gas Inspector for information about liners that are suitable for the locality.

608.9 Vent caps. A vent cap approved by the Chief Gas Inspector and that does not obstruct or reduce the effective cross-sectional area of the vent outlet, shall be used on all Type B, BW and single-wall metal and Type L vents.

608.10 Room exhausters and appliance blowers. A fan or blower shall not be discharged into any vent, chimney or vent connector into which a gas appliance is vented by natural draft, unless the vent connector from the natural draft gas appliance is connected to the suction side of the fan or blower.

608.11 Support of vents. All portions of gas vents shall be adequately supported for the design and weight of the materials employed.

SECTION 609 OUTSIDE VENTS

609.1 Material. Material for outside vents shall be resistant to the action of combustion products, and shall possess adequate insulation qualities or be adequately insulated to minimize condensation and aid draft. Special precautions shall be taken in severe climates and small-size vents.

609.2 Vent pipe support. When a vent is installed on the outside of the building, it shall be securely supported.

609.3 Prohibited installations. Natural draft vents extending through, and terminating adjacent to outside walls are prohibited.

SECTION 610 SPECIAL VENTING ARRANGEMENTS

610.1 Appliances with direct-vent systems.

610.1.1 Exclusions. The provisions of Sections 603 through 609 do not apply to listed, direct-vent appliances constructed and installed so that all air for combustion is derived from the outside atmosphere. Such appliances, having integral venting, shall be considered as being properly vented when they are installed in accordance with their listing and the manufacturer's installation instructions.

610.1.2 Venting system termination location. Vent terminals of direct-vent appliances shall be located not less than 9 inches from any opening through which combustion products could enter the building. A direct-vent appliance shall be installed in a building opening, such as a window.

The bottom of the vent terminal and the air intake shall be located a minimum of 12 inches above grade.

610.2 Appliances with integral vents.

610.2.1 General. Appliances incorporating integral venting means shall be considered properly vented when installed in accordance with their listings and the manufacturer's instructions.

610.2.2 Vent terminations. Appliances using natural draft venting shall be located so that a minimum clearance of 9 inches is maintained between vent terminals and from any openings through which combustion products could enter the building. Appliances using forced draft venting shall be located so that a minimum clearance of 12 inches is maintained between vent terminals and from any openings through which combustion products could enter the building.

610.3 Mechanical draft systems.

610.3.1 General. Appliances, except incinerators requiring venting, may also be vented by means of mechanical draft systems of either forced or induced draft design.

610.3.2 Forced draft systems and induced draft systems. Forced draft systems and all portions of induced draft systems under positive pressure during operation (i.e., Category III or IV appliances) shall be designed and installed to be gas-tight or to prevent leakage of combustion products into a building.

610.3.3 Automatic gas shut off. When a mechanical draft system is employed, provisions shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the appliance for safe performance.

610.3.4 Exit terminals. The exit terminals of mechanical draft systems shall be located not less than 12 inches from any opening through which combustion products could enter the building, nor less than 2 feet from an adjacent building, and not less than 7 feet above grade when located adjacent to public walkways.

610.3.5 Separation of natural draft and mechanical draft systems. A gas appliance vented by natural draft shall not be connected into a vent, chimney or vent connector on the discharge side of a mechanical flue exhauster.

610.3.6 Mechanical flue exhausters. The requirements of Subsections 608.2 and 608.3 are not applicable when mechanical flue exhausters are employed. Such systems shall be sized and installed according to the manufacturer's installation instructions.

610.4 Ventilating hoods and exhaust systems.

610.4.1 General. Ventilating hoods and exhaust systems may be used to vent gas-burning appliances installed in commercial applications.

610.4.2 Dampers prohibited. When automatically operated appliances, such as water heaters, are vented through natural draft ventilating hoods, dampers shall not be installed in the ventilating system.

610.4.3 Interlock for a power means of exhaust. When the ventilating hood or exhaust system is equipped with a power means of exhaust, the appliance control system shall be so interlocked as to permit appliance operation only when the power means of exhaust is in operation. An interlock is not required, however, when the operation of the power exhaust system is unnecessary for proper venting of unattended automatic appliances, such as water heaters.

SECTION 611 SIZING OF CATEGORY I APPLIANCE VENTING SYSTEMS

611.1 General. Category I appliance venting systems may be designed in accordance with the provisions of Subsection 611.2 or 611.3. The source for Tables 611.2A through 611.2E, and 611.3A through 611.3E is NFPA 54, *National Fuel Gas Code*. This material is reproduced with permission of the copyright holders, the American Gas Association (AGA) and the National Fire Protection Association (NFPA). All rights reserved.

611.1.1 Definitions. These definitions of terms are applicable to Tables 611.2A through 611.3E.

- (a) **FAN-ASSISTED COMBUSTION SYSTEM.** An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger.
- (b) **FAN MIN.** The minimum appliance input rating of a Category I appliance with a fan-assisted combustion system that could be attached to the vent.
- (c) **FAN MAX.** The maximum appliance input rating of a Category I appliance with a fan-assisted combustion system that could be attached to the vent.
- (d) **NAT MAX.** The maximum input rating of a Category I appliance equipped with a draft hood that could be attached to the vent. There are no minimum appliance input ratings for draft hood equipped appliances.
- (e) **FAN+FAN.** The maximum combined input rating of two or more fan-assisted appliances attached to the common vent.
- (f) **FAN+NAT.** The maximum combined input rating of one or more fan-assisted appliances, and one or more draft-hood-equipped appliances, attached to the common vent.
- (g) **NA.** Vent configuration is not applicable due to physical or geometric constraints.
- (h) **NAT+NAT.** The maximum combined input rating of two or more draft hood equipped appliances attached to the common vent.
- (i) **NR.** Vent configuration is not recommended because there is a potential for condensate formation and/or pressurization of the venting system.

611.1.2 Connections between different categories of appliances. Vent connectors serving Category I appliances shall not be connected to any portion of Category III or IV venting systems.

611.2 Application of single-appliance vent Figures 611.2A through 611.2D and Tables 611.2A through 611.2F. The application of Figures 611.2A through 611.2D and Tables 611.2A through 611.2E shall be subject to the requirements of Subsection 611.2.1 through 611.2.12.

611.2.1 Vent obstructions. These venting Tables shall not be used where obstructions, including draft regulators, safety controls, automatically operated vent dampers, economizers, heat reclaimers and recuperators, are installed in the venting system.

611.2.2 Minimum size. Where the vent size determined from these Tables is smaller than the appliance draft hood outlet or flue collar, the smaller size shall be permitted to be used provided:

- (a) The total vent height (H) is not less than 10 feet.
- (b) Vents for appliance draft hood outlets or flue collars, 12 inches in diameter or less, are not reduced more than one table size.
- (c) Vents for appliance draft hood outlets or flue collars greater than 12 inches in diameter are not reduced more than two table sizes.
- (d) The maximum capacity listed in these tables for a fan-assisted appliance is reduced by 10 percent (0.90 by maximum table capacity).
- (e) The draft hood outlet is greater than 4 inches in diameter. Do not connect a 3-inch-diameter vent to a 4-inch-diameter draft hood outlet. This provision shall not apply to fan-assisted appliances.

611.2.3 Vent offsets. Single-appliance venting configurations with zero lateral lengths in Tables 611.2A, 611.2B and 611.2E shall have no elbows in the venting system. For vent configurations with lateral lengths, these venting Tables include allowance for two 90-degree turns. For each additional 90-degree turn, or equivalent, the maximum capacity listed in the venting tables shall be reduced by 10 percent (0.90 by maximum table capacity).

Note: Two 45-degree turns are equivalent to one 90-degree turn.

611.2.4 Zero lateral. Zero lateral (L) shall apply only to a straight vertical vent attached to a top outlet draft hood or flue collar.

611.2.5 Multiple input rate appliances. For appliances with more than one input rate, the minimum vent capacity (FAN Min) determined from these Tables shall be less than the lowest appliance input rating, and the maximum vent capacity (FAN Max/NAT Max) determined from the tables shall be greater than the highest appliance rating input.

611.2.6 Liner system sizing and connections. Listed, corrugated metallic, chimney liner systems in masonry chimneys shall be sized by using Table 611.2A or 611.2B for Type B vents with the maximum capacity reduced by 20 percent (0.80 by maximum capacity) and the minimum capacity as shown in Table 611.2A or 611.2B. Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity additionally reduced. (See Subsection 611.2.3.)

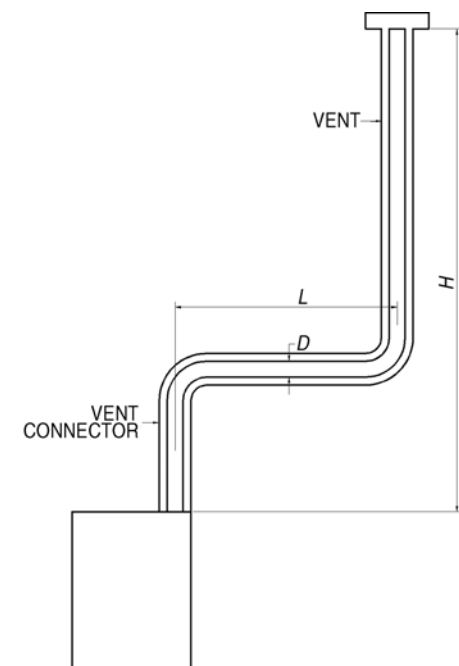


FIGURE 611.2A
TYPE B DOUBLE-WALL VENTS AND TYPE B DOUBLE-WALL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE
(SEE TABLE 611.2A)

Note: The appliance shall be either a Category I draft-hood-equipped or fan-assisted type.

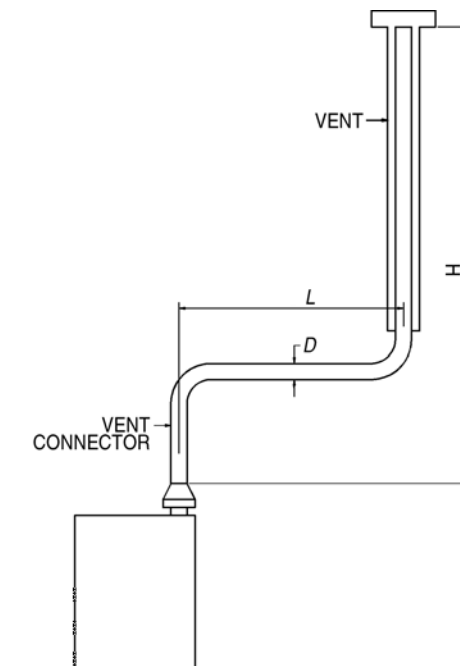


FIGURE 611.2B
TYPE B DOUBLE-WALL VENTS AND SINGLE-WALL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE
(SEE TABLE 611.2B)

Note: The appliance shall be either a Category I draft-hood-equipped or fan-assisted type.

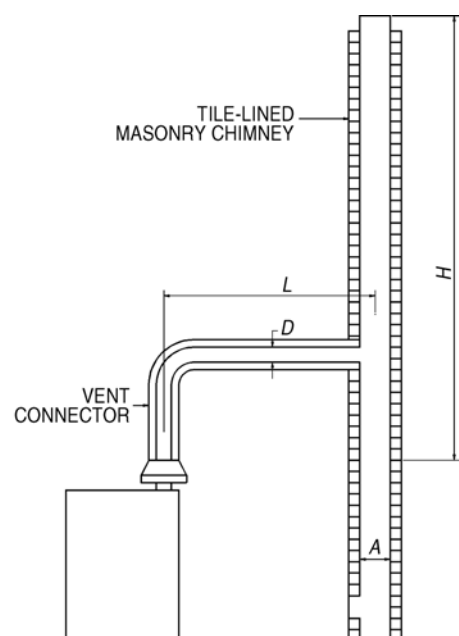


FIGURE 611.2C
MASONRY CHIMNEY AND TYPE B DOUBLE-WALL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE
(SEE TABLE 611.2C)

Notes:
 1. "A" is the equivalent cross-sectional area of the tile liner.
 2. The appliance shall be either a Category I draft-hood-equipped or fan-assisted type.

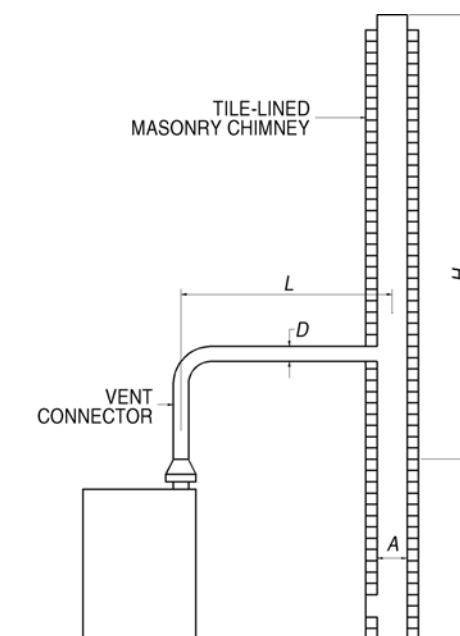


FIGURE 611.2D
MASONRY CHIMNEY AND SINGLE WALL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE
(SEE TABLE 611.2D).

Notes:
 1. "A" is the equivalent cross-sectional area of the tile liner.
 2. The appliance shall be either a Category I draft-hood-equipped or fan-assisted type.

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TABLE 611.2A
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE

HEIGHT <i>H</i> (feet)	LATERAL <i>L</i> (feet)	VENT DIAMETER— <i>D</i> (inches)																				
		3		4		5		6		7		8		9								
		Appliance input rating in thousands of Btu/h																				
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT			
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	63	543	370
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	93	536	362
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	110	530	354
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1,006	537
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	418
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	117	596	396
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1,096	585
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	57	684	457
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	95	671	446
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	122	651	427
15	0	0	94	48	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1,263	682
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	53	815	544
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	90	800	529
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	116	777	507
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275	115	580	373	134	755	491
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430	0	1,057	575	0	1,384	752
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346	41	711	470	50	917	612
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337	73	697	460	86	902	599
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	112	877	576
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308	111	654	427	129	853	557
	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	295	125	634	410	145	830	537
30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	475	0	1,173	650	0	1,548	855
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394	33	826	535	42	1,072	700
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	385	69	811	524	82	1,055	688
	10	27	70	50	37	150	102	48	262	171	59	405	261	77	580	371	91	788	507	107	1,028	668
	15	33	64	NR	44	141	96	57	249	163	70	389	249	90	560	357	105	765	490	124	1,002	648
	20	56	58	NR	53	132	90	66	237	154	80	374	237	102	542	343	119	743	473	139	977	628
	30	NR	NR	NR	73	113	NR	88	214	NR	104	346	219	131	507	321	149	702	444	171	929	594
50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	518	0	1,297	708	0	1,730	952
	2	8	86	61	11	183	122	14	320	206	15	497	314	22	715	445	26	975	615	33	1,276	813
	5	20	82	NR	27	177	119	35	312	200	43	487	308	55	702	438	65	960	605	77	1,259	798
	10	26	76	NR	35	168	114	45	299	190	56	471	298	73	681	426	86	935	589	101	1,230	773
	15	59	70	NR	42	158	NR	54	287	180	66	455	288	85	662	413	100	911	572	117	1,203	747
	20	NR	NR	NR	50	148	NR	63	275	169	76	440	278	97	642	401	113	888	556	131	1,176	722
	30	NR	NR	NR	69	131	NR	84	250	NR	99	410	259	123	605	376	141	844	522	161	1,125	670
100	0	NR	NR	NR	9	218	NR	0	407	NR	0	665	400	0	997	560	0	1,411	770	0	1,908	1,040
	2	NR	NR	NR	10	194	NR	12	354	NR	13	566	375	18	831	510	21	1,155	700	25	1,536	935
	5	NR	NR	NR	26	189	NR	33	347	NR	40	557	369	52	820	504	60	1,141	692	71	1,519	926
	10	NR	NR	NR	33	182	NR	43	335	NR	53	542	361	68	801	493	80	1,118	679	94	1,492	910
	15	NR	NR	NR	40	174	NR	50	321	NR	62	528	353	80	782	482	93	1,095	666	109	1,465	895
	20	NR	NR	NR	47	166	NR	59	311	NR	71	513	344	90	763	471	105	1,073	653	122	1,438	880
	30	NR	NR	NR	NR	NR	NR	78	290	NR	92	483	NR	115	726	449	131	1,029	627	149	1,387	849
	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	147	428	NR	180	651	405	197	944	575	217	1,288	787

(continued)

TABLE 611.2A—(continued)
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE

HEIGHT <i>H</i> (feet)	LATERAL <i>L</i> (feet)	VENT DIAMETER— <i>D</i> (inches)																							
		10		12		14		16		18		20		22		24									
		Appliance input rating in thousands of Btu/h																							
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT					
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	1,121	570	0	1,645	850	0	2,267	1,170	0	2,983	1,530	0	3,802	1,960	0	4,721	2,430	0	5,737	2950	0	6,853	3,520
	2	75	675	455	103	982	650	138	1,346	890	178	1,769	1,170	225	2,250	1,480	296	2,782	1,850	360	3,377	2,220	426	4,030	2,670
	4	110	668	445	147	975	640	191	1,338	880	242	1,761	1,160	300	2,242	1,475	390	2,774	1,835	469	3,370	2,215	555	4,023	2,660
	6	128	661	435	171	967	630	219	1,330	870	276	1,753	1,150	341	2,235	1,470	437	2,767	1,820	523	3,363	2,210	618	4,017	2,650
8	0	0	1,261	660	0	1,858	970	0	2,571	1,320	0	3,399	1,740	0	4,333	2,220	0	5,387	2,750	0	6,555	3,360	0	7,838	4,010
	2	71	770	515	98	1,124	745	130	1,543	1,020	168	2,030	1,340	212	2,584	1,700	278	3,196	2,110	336	3,882	2,560	401	4,634	3,050
	5	115	758	503	154	1,110	733	199	1,528	1,010	251	2,013	1,330	311	2,663	1,685	398	3,180	2,090	476	3,863	2,545	562	4,612	3,040
	8	137	746	490	180	1,097	720	231	1,514	1,000	289	2,000	1,320	354	2,552	1,670	450	3,163	2,070	537	3,850	2,530	630	4,602	3,030
10	0	0	1,377	720	0	2,036	1,060	0	2,825	1,450	0	3,742	1,925	0	4,782	2,450	0	5,955	3,050	0	7,254	3,710	0	8,682	4,450
	2	68	852	560	93	1,244	850	124	1,713	1,130	161	2,256	1,480	202	2,868	1,890	264	3,556	2,340	319	4,322	2,840	378	5,153	3390
	5	112	839	547	149	1,229	829	192	1,696	1,105	243	2,238	1,461	300	2,849	1,871	382	3,536	2,318	458	4,301	2,818	540	5,132	3371
	10	142	817	525	187	1,204	795	238	1,669	1,080	298	2,209	1,430	364	2,818	1,840	459	3,504	2,280	546	4,268	2,780	641	5,099	3340
15	0	0	1,596	840	0	2,380	1,240	0	3,323	1,720	0	4,423	2,270	0	5,678	2,900	0	7,099	3,620	0	8,665	4,410	0	10,393	5300
	2	63	1,019	675	86	1,495	985	114	2,062	1,350	147	2,719	1,770	186	3,467	2,260	239	4,304	2,800	290	5,232	3,410	346	6,251	4,080
	5	105	1,003	660	140	1,476	967	182	2,041	1,327	229	2,696	1,748	283	3,442	2,235	355	4,278	2,777	426	5,204	3,385	501	6,222	4,057
	10	135	977	635	177	1,446	936	227	2,009	1,289	283	2,659	1,712	346	3,402	2,193	432	4,234	2,739	510	5,159	3,343	599	6,175	4,019
20	15	155	953	610	202	1,418	905	257	1,976	1,250	318	2,623	1,675	385	3,363	2,150	479	4,192	2,700	564	5,115	3,300	665	6,129	3,980
	0	0	1,756	930	0	2,637	1,350	0	3,701	1,900	0	4,948	2,520	0	6,376	3,250	0	7,988	4,060	0	9,785	4,980	0	11,753	6,000
	2	59	1,150	755	81	1,694	1,100	107	2,343	1,520	139	3,097	2,000	175	3,955	2,570	220	4,916	3,200	269	5,983	3,910	321	7,154	4,700
	5	101	1,133	738	135	1,674	1,079	174	2,320	1,498	219	3,071	1,978	270	3,926	2,544	337	4,885	3,174	403	5,950	3,880	475	7,119	4,662
30	10	130	1,105	710	172	1,641	1,045	220	2,282	1,460	273	3,029	1,940	334	3,880	2,500	413	4,835	3,130	489	5,896	3,830	573	7,063	4,600
	15	150	1,078	688	195	1,609	1,018	248	2,245	1,425	306	2,988	1,910	372	3,835	2,465	459	4,786	3,090	541	5,844	3,795	631	7,007	4,575
	20	167	1,052	665	217	1,578	990	273	2,210	1,390	335	2,948	1,880	404	3,791	2,430	495	4,737	3,050	585	5,792	3,760	689	6,953	4,550
	0	0	1,977	1,060	0	3,004	1,550	0	4,252	2,170	0	5,725	2,920	0	7,420	3,770	0	9,341	4,750	0	11,483	5,850	0	13,848	7,060
50	2	54	1,351	865	74	2,004	1,310	98	2,786	1,800	127	3,696	2,380	159	4,734	3,050	199	5,900	3,810	241	7,194	4,650	285	8,617	5,600
	5	96	1,332	851	127	1,981	1,289	164	2,759	1,775	206	3,666	2,350	252	4,701	3,020	312	5,863	3,783	373	7,155	4,622	439	8,574	5,552
	10	125	1,301	829	164	1,944	1,254	209	2,716	1,733	259	3,617	2,300	316	4,647	2,970	386	5,803	3,739	456	7,090	4,574	535	8,505	5,471
	15	143	1,272	807	187	1,908	1,220	237	2,674	1,692	292	3,570	2,250	354	4,594	2,920	431	5,744	3,695	507	7,026	4,527	590	8,437	5,391
100	20	160	1,243	784	207	1,873	1,185	260	2,633	1,650	319	3,523	2,200	384	4,542	2,870	467	5,686	3,650	548	6,964	4,480	639	8,370	5,310
	30	195	1,189	745	246	1,807	1,130	305	2,555	1,585	369	3,433	2,130	440	4,442	2,785	540	5,574	3,565	635	6,842	4,375	739	8,239	5,225
	0	0	2,231	1,195	0	3,441	1,825	0	4,934	2,550	0	6,711	3,440	0	8,774	4,460	0	11,129	5,635	0	13,767	6,940	0	16,694	8,430
	2	41	1,620	1,010	66	2,431	1,513	86	3,409	2,125	113	4,554	2,840	141	5,864	3,670	171	7,339	4,630	209	8,980	5,695	251	10,788	6,860
100	5	90	1,600	996	118	2,406	1,495	151	3,380	2,102	191	4,520	2,813	234	5,826	3,639	283	7,295	4,597	335	8,933	5,654	394	10,737	6,818
	10	118	1,567	972	154	2,366	1,466	196	3,332	2,064	243	4,464	2,767	295	5,763	3,585	355	7,224	4,542	419	8,855	5,585	491	10,652	6,749
	15	136	1,536	948	177	2,327	1,437	222	3,285	2,026	274	4,409	2,721	330	5,701	3,534	396	7,155	4,511	465	8,779	5,546	542	10,570	6,710
	20	151	1,505	924	195	2,288	1,408	244	3,239	1,987	300	4,356	2,675	361	5,641	3,481	433	7,086	4,479	506	8,704	5,506	586	10,488	6,670
100	30	183	1,446	876	232	2,214	1,349	287	3,150	1,910	347	4,253	2,631	412	5,523	3,431	494	6,953	4,421	577	8,557	5,444	672	10,328	6,603
	0	0	2,491	1,310	0	3,925	2,050	0	5,729	2,950	0	7,914	4,050	0	10,485	5,300	0	13,454	6,700	0	16,817	8,600	0	20,578	10,300
	2	30	1,975	1,170	44	3,027	1,820	72	4,313	2,550	95	5,834	3,500	120	7,591	4,600	138	9,577	5,800	169	11,803	7,200	204	14,264	8,800
	5	82	1,955	1,159	107	3,002	1,803	136	4,282	2,531	172	5,797	3,475	208	7,548	4,566	245	9,528	5,769	293	11,748	7,162	341	14,204	8,756
100	10	108	1,923	1,142	142	2,961	1,775	180	4,231	2,500	223	5,737	3,434	268	7,478	4,509	318	9,447	5,717	374	11,658	7,100	426	14,105	8,683
	15	126	1,892	1,124	163	2,920	1,747	206	4,182	2,469	252	5,678	3,392	304	7,409	4,451	358	9,367	5,665	418	11,569	7,037	487	14,007	8,610
	20	141	1,861	1,107	181	2,880	1,719	226	4,133	2,438	277	5,619	3,351	330	7,341	4,394	387	9,289	5,613	452	11,482	6,975	523	13,910	8,537
	30	170	1,802	1,071	215	2,803	1,663	265	4,037	2,375	319	5,505	3,267	378	7,209	4,279	446	9,136	5,509	514	11,310	6,850	592	13,720	8,391
100	50	241	1,688	1,000	292	2,657	1,550	350	3,856	2,250	415	5,289	3,100	486	6,956	4,050	572	8,841	5,300	659	10,979	6,600	752	13,354	8,100

TABLE 611.2B
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH SINGLE-WALL METAL
CONNECTORS SERVING A SINGLE CATEGORY I APPLIANCE

HEIGHT H (feet)	LATERAL L (feet)	VENT DIAMETER—D (Inches)																																			
		3				4				5				6				7				8				9				10				12			
		Appliance input rating in thousands of Btu/h																																			
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT						
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max								
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	284	211	695	369	267	894	469	371	1,118	569	537	1,639	849									
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213	201	423	284	251	541	368	347	673	453	498	979	648									
	4	NR	NR	33	74	92	63	102	152	102	146	225	152	187	313	208	237	416	277	295	533	360	409	664	443	584	971	638									
	6	NR	NR	31	83	89	60	114	147	99	163	220	148	207	307	203	263	409	271	327	526	352	449	656	433	638	962	627									
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319	206	777	414	258	1,002	536	360	1,257	658	521	1,852	967									
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246	197	482	321	246	617	417	339	768	513	486	1,120	743									
	5	NR	NR	37	77	102	69	107	168	114	151	252	171	193	352	235	245	470	311	305	604	404	418	754	500	598	1,104	730									
	8	NR	NR	33	90	95	64	122	161	107	175	243	163	223	342	225	280	458	300	344	591	392	470	740	486	665	1,089	715									
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344	202	844	449	253	1,093	584	351	1,373	718	507	2,031	1,057									
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	272	193	531	354	242	681	456	332	849	559	475	1,242	848									
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261	241	518	344	299	667	443	409	834	544	584	1,224	825									
	10	NR	NR	34	97	100	68	132	171	112	188	261	171	237	369	241	296	497	325	363	643	423	492	808	520	688	1,194	788									
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388	195	966	523	244	1,259	681	336	1,591	838	488	2,374	1,237									
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	214	187	631	413	232	812	543	319	1,015	673	457	1,491	983									
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298	231	616	400	287	795	526	392	997	657	562	1,469	963									
	10	NR	NR	39	95	116	79	128	201	131	182	308	203	228	438	284	284	592	381	349	768	501	470	966	628	664	1,433	928									
20	15	NR	NR	NR	NR	NR	72	158	186	124	220	290	192	272	418	269	334	568	367	404	742	484	540	937	601	750	1,399	894									
	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428	190	1,053	573	238	1,379	750	326	1,751	927	473	2,631	1,346									
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344	182	708	468	227	914	611	309	1,146	754	443	1,689	1,098									
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334	224	692	457	279	896	596	381	1,126	734	547	1,665	1,074									
30	10	NR	NR	41	93	129	86	125	223	146	177	344	224	222	491	316	277	666	437	339	866	570	457	1,092	702	646	1,626	1,037									
	15	NR	NR	NR	NR	NR	80	155	208	136	216	325	210	264	469	301	325	640	419	393	838	549	526	1,060	677	730	1,587	1,005									
	20	NR	NR	NR	NR	NR	NR	186	192	126	254	306	196	309	448	285	374	616	400	448	810	526	592	1,028	651	808	1,550	973									
	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472	184	1,168	647	229	1,542	852	312	1,971	1,056	454	2,996	1,545									
50	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392	175	823	533	219	1,069	698	296	1,346	863	424	1,999	1,308									
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382	215	806	521	269	1,049	684	366	1,324	846	524	1,971	1,283									
	10	NR	NR	NR	91	144	98	122	255	168	171	397	257	213	570	367	265	777	501	327	1,017	662	440	1,287	821	620	1,927	1,243									
	15	NR	NR	NR	115	131	NR	151	239	157	208	377	242	255	547	349	312	750	481	379	985	638	507	1,251	794	702	1,884	1,205									
100	20	NR	NR	NR	NR	NR	NR	181	223	NR	246	357	228	298	524	333	360	723	461	433	955	615	570	1,216	768	780	1,841	1,166									
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	389	477	305	461	670	426	541	895	574	704	1,147	720	937	1,759	1,101								
	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	515	176	1,292	704	220	1,724	948	295	2,223	1,189	428	3,432	1,818									
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	443	168	971	613	209	1,273	811	280	1,615	1,007	401	2,426	1,509									
50	5	48	80	NR	70	174	117	94	308	198	131	482	305	164	696	435	204	953	602	257	1,252	795	347	1,591	991	496	2,396	1,490									
	10	NR	NR	NR	89	160	NR	118	292	186	162	461	292	203	671	420	253	923	583	313	1,217	765	418	1,551	963	589	2,347	1,455									
	15	NR	NR	NR	112	148	NR	145	275	174	199	441	280	244	646	405	299	894	562	363	1,183	736	481	1,512	934	668	2,299	1,421									
	20	NR	NR	NR	NR	NR	NR	176	257	NR	236	420	267	285	622	389	345	866	543	415	1,150	708	544	1,473	906	741	2,251	1,387									
100	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	315	376	NR	373	573	NR	442	809	502	521	1,086	649	674	1,399	848	892	2,159	1,318									
	0	NR	NR	NR	49	214	NR	69	403	NR	100	659	395	131	991	555	166	1,404	765	207	1,900	1,033	273	2,479	1,300	395	3,912	2,042									
	2	NR	NR	NR	51	192	NR	70	351	NR	98	563	373	125	828	508	158	1,152	698	196	1,532	933	259	1,970	1,168	371	3,021	1,817									
	5	NR	NR	NR	67	186	NR	90	342	NR	125	551	366	156	813	501	194	1,134	688	240	1,511	921	322	1,945	1,153	460	2,990	1,796									
100	10	NR	NR	NR	85	175	NR	113	324	NR	153	532	354	191	789	486	238	1,104	672	293	1,477	902	389	1,905	1,133	547	2,938	1,763									
	15	NR	NR	NR	132	162	NR	138	310	NR	188	511	343	230	764	473	281	1,075	656	342	1,443	884	447	1,865	1,110	618	2,888	1,730									
	20	NR	NR	NR	NR	NR	NR	168	295	NR	224	487	NR	270	739	458	325	1,046	639	391	1,410	864	507	1,825	1,087	690	2,838	1,696									
	30	NR	NR	NR	NR	NR	NR	231	264	NR	301	448	NR	355	685	NR	418	988	NR	491	1,343	824	631	1,747	1,041	834	2,739	1,627									
100	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	540	584	NR	617	866	NR	711	1,205	NR	895	1,591	NR	1,138	2,547	1,489									

TABLE 611.2C
CAPACITY OF MASONRY CHIMNEY FLUE WITH TYPE B DOUBLE-WALL VENT CONNECTORS
SERVING A SINGLE CATEGORY I APPLIANCE

HEIGHT H (feet)	LATERAL L (feet)	TYPE B DOUBLE-WALL CONNECTOR DIAMETER—D TO BE USED WITH CHIMNEY AREAS WITHIN THE SIZE LIMITS AT BOTTOM (inches)																																			
		3		4		5		6		7		8		9		10		12																			
		Appliance input rating in thousands of Btu/h																																			
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT									
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max								
6	2	NR	NR	28	NR	NR	52	NR	NR	86	NR	NR	130	NR	NR	180	NR	NR	247	NR	NR	320	NR	NR	401	NR	NR	581									
	5	NR	NR	25*	NR	NR	49	NR	NR	82	NR	NR	117	NR	NR	165	NR	NR	231	NR	NR	298	NR	NR	376	NR	NR	561									
8	2	NR	NR	29	NR	NR	55	NR	NR	93	NR	NR	145	NR	NR	198	NR	NR	266	84	590	350	100	728	446	139	1,024	651									
	5	NR	NR	26*	NR	NR	52	NR	NR	88	NR	NR	134	NR	NR	183	NR	NR	247	NR	NR	328	149	711	423	201	1,007	640									
	8	NR	NR	24*	NR	NR	48*	NR	NR	83	NR	NR	127	NR	NR	175	NR	NR	239	NR	NR	318	173	695	410	231	990	623									
10	2	NR	NR	31	NR	NR	61	NR	NR	103	NR	NR	162	NR	NR	221	68	519	298	82	655	388	98	810	491	136	1,144	724									
	5	NR	NR	28*	NR	NR	57	NR	NR	96	NR	NR	148	NR	NR	204	NR	NR	277	124	638	365	146	791	466	196	1,124	712									
	10	NR	NR	25*	NR	NR	50*	NR	NR	87	NR	NR	139	NR	NR	191	NR	NR	263	155	610	347	182	762	444	240	1,093	668									
15	2	NR	NR	35*	NR	NR	67	NR	NR	114	NR	NR	179	53	475	250	64	613	336	77	779	441	92	968	562	127	1,376	841									
	5	NR	NR	35*	NR	NR	62	NR	NR	107	NR	NR	164	NR	NR	231	99	594	313	118	759	416	139	946	533	186	1,352	828									
	10	NR	NR	28*	NR	NR	55*	NR	NR	97	NR	NR	153	NR	NR	216	126	565	296	148	727	394	173	912	567	229	1,315	777									
	15	NR	NR	NR	NR	NR	48*	NR	NR	89*	NR	NR	141	NR	NR	201	NR	NR	281	171	698	375	198	880	485	259	1,280	742									
20	2	NR	NR	38*	NR	NR	74	NR	NR	124	NR	NR	201	51	522	274	61	678	375	73	867	491	87	1,083	627	121	1,548	953									
	5	NR	NR	36*	NR	NR	68*	NR	NR	116	NR	NR	184	80	503	254	95	658	350	113	845	463	133	1,059	597	179	1,523	933									
	10	NR	NR	NR	NR	NR	60*	NR	NR	107*	NR	NR	172	NR	NR	237	122	627	332	143	811	440	167	1,022	566	221	1,482	879									
	15	NR	NR	NR	NR	NR	NR	NR	NR	97*	NR	NR	159	NR	NR	220	NR	NR	314	165	780	418	191	987	541	251	1,443	840									
	20	NR	NR	NR	NR	NR	NR	NR	NR	83*	NR	NR	148*	NR	NR	206	NR	NR	296	186	750	397	214	955	513	277	1,406	807									
30	2	NR	NR	41*	NR	NR	82*	NR	NR	137	NR	NR	216	47	581	303	57	762	421	68	985	558	81	1,240	717	111	1,793	1,112									
	5	NR	NR	NR	NR	NR	76*	NR	NR	128*	NR	NR	198	75	561	281	90	741	393	106	962	526	125	1,216	683	169	1,766	1,094									
	10	NR	NR	NR	NR	NR	67*	NR	NR	115*	NR	NR	184*	NR	NR	263	115	709	373	135	927	500	158	1,176	648	210	1,721	1,025									
	15	NR	NR	NR	NR	NR	NR	NR	NR	107*	NR	NR	171*	NR	NR	243*	NR	NR	353	156	893	476	181	1,139	621	239	1,679	981									
	20	NR	NR	NR	NR	NR	NR	NR	NR	91*	NR	NR	159*	NR	NR	227*	NR	NR	332	176	860	450	203	1,103	592	264	1,638	940									
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	188*	NR	NR	288*	NR	NR	416	249	1,035	555	318	1,560	877									
50	2	NR	NR	NR	NR	NR	92*	NR	NR	161*	NR	NR	251*	NR	NR	351*	51	840	477	61	1,106	633	72	1,413	812	99	2,080	1,243									
	5	NR	NR	NR	NR	NR	NR	NR	NR	151*	NR	NR	230*	NR	NR	323*	83	819	445	98	1,083	596	116	1,387	774	155	2,052	1,225									
	10	NR	NR	NR	NR	NR	NR	NR	NR	138*	NR	NR	215*	NR	NR	304*	NR	NR	424*	126	1,047	567	147	1,347	733	195	2,006	1,147									
	15	NR	NR	NR	NR	NR	NR	NR	NR	127*	NR	NR	199*	NR	NR	282*	NR	NR	400*	146	1,010	539*	170	1,307	702	222	1,961	1,099									
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	185*	NR	NR	264*	NR	NR	376*	165	977	511*	190	1,269	669*	246	1,916	1,050									
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	327*	NR	NR	468*	233	1,196	623*	295	1,832	984									
Minimum Internal Area of Chimney (square inches)		12				19				28				38				50				63				78				95				132			
Maximum Internal Area of Chimney (square inches)		49				88				137				198				269				352				445				550				792			

Note: Numbers followed by an asterisk (*) indicate the possibility of continuous condensation, depending upon locality. Consult the appliance manufacturer, gas utility company or Chief Gas Inspector.

611.2.7 Vent area and diameter. Where the vertical vent has a larger diameter than the vent connector, the vertical vent diameter shall be used to determine the minimum vent capacity, and the connector diameter shall be used to determine the maximum vent capacity. The flow area of the vertical vent shall not exceed seven times the flow area of the listed appliance categorized vent area, flue collar area or draft hood outlet area, unless designated in accordance with approved engineering methods.

611.2.8 Outdoor exposure. Tables 611.2A through 611.2E shall be used for chimneys and vents not exposed to the outdoors below the roof line. Chimneys or vents exposed to the outdoors below the roof line may experience continuous condensation, depending on their locality. Consult the appliance manufacturer, gas utility company or Chief Gas Inspector. A Type B vent or listed chimney liner system passing through an unused masonry chimney flue shall not be considered as exposed to the outdoors.

TABLE 611.2D
CAPACITY OF MASONRY CHIMNEY FLUE WITH SINGLE-WALL VENT CONNECTORS
SERVING A SINGLE CATEGORY I APPLIANCE

HEIGHT H (feet)	LATERAL L (feet)	SINGLE-WALL CONNECTOR DIAMETER—D TO BE USED WITH CHIMNEY AREAS WITHIN THE SIZE LIMITS AT BOTTOM (inches)																											
		3		4		5		6		7		8		9		10		12											
		Appliance input rating in thousands of Btu/h																											
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min
6	2 5	NR	NR	28	NR	NR	52	NR	NR	86	NR	NR	130	NR	NR	180	NR	NR	247	NR	NR	319	NR	NR	400	NR	NR	580	
		NR	NR	25*	NR	NR	48	NR	NR	81	NR	NR	116	NR	NR	164	NR	NR	230	NR	NR	297	NR	NR	375	NR	NR	560	
8	2	NR	NR	29	NR	NR	55	NR	NR	93	NR	NR	145	NR	NR	197	NR	NR	265	NR	NR	349	382	725	445	549	1,021	650	
	5	NR	NR	26*	NR	NR	51	NR	NR	87	NR	NR	133	NR	NR	182	NR	NR	246	NR	NR	327	NR	NR	422	673	1,003	638	
	8	NR	NR	23*	NR	NR	47*	NR	NR	82	NR	NR	126	NR	NR	174	NR	NR	237	NR	NR	317	NR	NR	408	747	985	621	
10	2	NR	NR	31	NR	NR	61	NR	NR	102	NR	NR	161	NR	NR	220	216	518	297	271	654	387	373	808	490	536	1,142	722	
	5	NR	NR	28*	NR	NR	56	NR	NR	95	NR	NR	147	NR	NR	203	NR	NR	276	334	635	364	459	789	465	657	1,121	710	
	10	NR	NR	24*	NR	NR	49*	NR	NR	86	NR	NR	137	NR	NR	189	NR	NR	261	NR	NR	345	547	758	441	771	1,088	665	
15	2	NR	NR	35*	NR	NR	67	NR	NR	113	NR	NR	178	166	473	249	211	611	335	264	776	440	362	965	560	520	1,373	840	
	5	NR	NR	32*	NR	NR	61	NR	NR	106	NR	NR	163	NR	NR	230	261	591	312	325	755	414	444	942	531	637	1,348	825	
	10	NR	NR	27*	NR	NR	54*	NR	NR	96	NR	NR	151	NR	NR	214	NR	NR	294	392	722	392	531	907	504	749	1,309	774	
	15	NR	NR	NR	NR	NR	46*	NR	NR	87*	NR	NR	138	NR	NR	198	NR	NR	278	452	692	372	606	873	481	841	1,272	738	
20	2	NR	NR	38*	NR	NR	73	NR	NR	123	NR	NR	200	163	520	273	206	675	374	258	864	490	252	1,079	625	508	1,544	950	
	5	NR	NR	35*	NR	NR	67*	NR	NR	115	NR	NR	183	NR	NR	252	255	655	348	317	842	461	433	1,055	594	623	1,518	930	
	10	NR	NR	NR	NR	NR	59*	NR	NR	105*	NR	NR	170	NR	NR	235	312	622	330	382	806	437	517	1,016	562	733	1,475	875	
	15	NR	NR	NR	NR	NR	NR	NR	NR	95*	NR	NR	156	NR	NR	217	NR	NR	311	442	773	414	591	979	539	823	1,434	835	
	20	NR	NR	NR	NR	NR	NR	NR	NR	80*	NR	NR	144*	NR	NR	202	NR	NR	292	NR	NR	392	664	944	510	911	1,394	800	
30	2	NR	NR	41*	NR	NR	81*	NR	NR	136	NR	NR	215	158	578	302	200	759	420	249	982	556	340	1,237	715	489	1,789	1,110	
	5	NR	NR	NR	NR	NR	75*	NR	NR	127*	NR	NR	196	NR	NR	279	245	737	391	306	958	524	417	1,210	680	600	1,760	1,090	
	10	NR	NR	NR	NR	NR	66*	NR	NR	113*	NR	NR	182*	NR	NR	260	300	703	370	370	920	496	500	1,168	644	708	1,713	1,020	
	15	NR	NR	NR	NR	NR	NR	NR	NR	105*	NR	NR	168*	NR	NR	240*	NR	NR	349	428	884	471	572	1,128	615	798	1,668	975	
	20	NR	NR	NR	NR	NR	NR	NR	NR	88*	NR	NR	155*	NR	NR	223*	NR	NR	327	NR	NR	445	643	1,089	585	883	1,624	932	
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	182*	NR	NR	281*	NR	NR	408	NR	NR	544	1055	1,539	865	
50	2	NR	NR	NR	NR	NR	91*	NR	NR	160*	NR	NR	250*	NR	NR	350*	191	837	475	238	1,103	631	323	1,408	810	463	2,076	1,240	
	5	NR	NR	NR	NR	NR	NR	NR	NR	149*	NR	NR	228*	NR	NR	321*	NR	NR	442	293	1,078	593	398	1,381	770	571	2,044	1,220	
	10	NR	NR	NR	NR	NR	NR	NR	NR	136*	NR	NR	212*	NR	NR	301*	NR	NR	420*	355	1,038	562	447	1,337	728	674	1,994	1,140	
	15	NR	NR	NR	NR	NR	NR	NR	NR	124*	NR	NR	195*	NR	NR	278*	NR	NR	395*	NR	NR	533*	546	1,294	695	761	1,945	1,090	
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	180*	NR	NR	258*	NR	NR	370*	NR	NR	504*	616	1,251	660*	844	1,898	1,040	
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	318*	NR	NR	458*	NR	NR	610*	1,009	1,805	970	
Minimum Internal Area of Chimney (square inches)		12		19		28		38		50		63		78		95		132											
Maximum Internal Area of Chimney (square inches)		49		88		137		198		269		352		445		550		792											

Note: Numbers followed by an asterisk (*) indicate the possibility of continuous condensation, depending upon locality. Consult the appliance manufacturer, gas utility company or Chief Gas Inspector.

611.2.9 Upsizing. Vent connectors shall not be upsized more than two sizes greater than the listed appliance-categorized vent diameter, flue collar diameter or draft-hood-outlet diameter.

611.2.10 Single-run type and diameter. In a single run of vent or vent connector, more than one diameter and type shall be permitted to be used, provided that all the sizes and types are permitted by these Tables.

611.2.11 Interpolation permitted. Interpolation shall be permitted in calculating capacities for vent dimensions that fall between Table entries. (See Appendix B.)

611.2.12 Extrapolation prohibited. Extrapolation beyond these Table entries shall not be permitted.

TABLE 611.2E
CAPACITY OF SINGLE-WALL METAL PIPE

HEIGHT <i>H</i> (feet)	LATERAL <i>L</i> (feet)	VENT DIAMETER— <i>D</i> (inches)							
		3	4	5	6	7	8	10	12
		Maximum appliance input rating in thousands of Btu/h							
6	0	39	70	116	170	232	312	500	750
	2	31	55	94	141	194	260	415	620
	5	28	51	88	128	177	242	390	600
8	0	42	76	126	185	252	340	542	815
	2	32	61	102	154	210	284	451	680
	5	29	56	95	141	194	264	430	648
	10	24*	49	86	131	180	250	406	625
10	0	45	84	138	202	279	372	606	912
	2	35	67	111	168	233	311	505	760
	5	32	61	104	153	215	289	480	724
	10	27*	54	94	143	200	274	455	700
	15	NR	46*	84	130	186	258	432	666
15	0	49	91	151	223	312	420	684	1,040
	2	39	72	122	186	260	350	570	865
	5	35*	67	110	170	240	325	540	825
	10	30*	58*	103	158	223	308	514	795
	15	NR	50*	93*	144	207	291	488	760
	20	NR	NR	82*	132*	195	273	466	726
20	0	53*	101	163	252	342	470	770	1,190
	2	42*	80	136	210	286	392	641	990
	5	38*	74*	123	192	264	364	610	945
	10	32*	65*	115*	178	246	345	571	910
	15	NR	55*	104*	163	228	326	550	870
	20	NR	NR	91*	149*	214*	306	525	832
30	0	56*	108*	183	276	384	529	878	1,370
	2	44*	84*	148*	230	320	441	730	1,140
	5	NR	78*	137*	210	296	410	694	1,080
	10	NR	68*	125*	196*	274	388	656	1,050
	15	NR	NR	113*	177*	258*	366	625	1,000
	20	NR	NR	99*	163*	240*	344	596	960
	30	NR	NR	NR	NR	192*	295*	540	890
50	0	NR	120*	210*	310*	443*	590	980	1,550
	2	NR	120*	171*	260*	370*	492	820	1,290
	5	NR	95*	159*	234*	342*	474	780	1,230
	10	NR	NR	146*	221*	318*	456*	730	1,190
	15	NR	NR	NR	200*	292*	407*	705	1,130
	20	NR	NR	NR	185*	276*	384*	670*	1,080
	30	NR	NR	NR	NR	222*	330*	605*	1,010

Note: Numbers followed by an asterisk (*) indicate the possibility of continuous condensation, depending upon locality. Consult the appliance manufacturer, gas utility company or Chief Gas Inspector.

611.3 Application of multiple appliance vent Figures 611.3A through 611.3D, 611.3D.1 and 611.3D.2 and Tables 611.3A through 611.3A.2, 611.3B.1 through 611.3B.2, 611.3C.1 through 611.3C.2, 611.3D.1 through 611.3D.2, 611.3E.1 through 611.3E.2 and 611.3F. The application of Figures 611.3A through 611.3D.2 and Tables 611.3A through 611.3F shall be subject to the requirements of Sections 611.3.1 through 611.3.21.

611.3.1 Vent obstructions. These venting Tables shall not be used where obstructions, including draft regulators, safety controls, automatically operated vent dampers, economizers, heat reclaimers and recuperators, are installed in the venting system.

611.3.2 Connector length limit. The maximum vent connector horizontal length shall be 1½ feet for each 1 inch of the connector diameter as shown in Table 611.3A.

**TABLE 611.3A
MAXIMUM VENT CONNECTOR LENGTH**

CONNECTOR DIAMETER (inches)	MAXIMUM CONNECTOR HORIZONTAL LENGTH (feet)
3	4½
4	6
5	7½
6	9
7	10½
8	12
9	13½
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

611.3.3 Shortest route. The vent connector shall be routed to the vent utilizing the shortest possible route. Connectors with longer horizontal lengths than those listed in Table 611.3A are permitted in accordance with the conditions of Subsections 611.3.3.1 and 611.3.3.2.

611.3.3.1 Maximum capacity reduction. The maximum capacity (FAN Max/Nat Max) of the vent connector shall be reduced 10 percent for each additional multiple of the length listed in Table 611.3A. For example, the maximum length listed in Table 611.3A for a 4-inch connector is 6 feet. With a connector length greater than 6 feet, but not greater than 12 feet, the maximum capacity must be reduced by 10 percent (0.90 by maximum vent connector capacity). With a connector length greater than 12 feet, but not exceeding 18 feet, the maximum capacity must be reduced by 20 percent (0.80 by maximum vent capacity).

611.3.3.2 Minimum capacity. The minimum capacity (FAN Min) shall be determined by referring to the corresponding single-appliance table (see Tables 611.2A

and 611.2B). In this case, for each appliance, the entire vent connector and common vent from the appliance to the vent termination shall be treated as a single-appliance vent, as if the other appliances were not present.

611.3.4 Vent connector manifold. Where the vent connectors are combined prior to entering the common vent, the maximum common vent capacity listed in the common venting tables shall be reduced by 10 percent (0.90 by maximum common-vent capacity). The length of the common-vent connector manifold (L_o) shall not be greater than 1½ feet for each 1 inch of the common-vent connector manifold diameter (D). (See Figure 611.3D.1.)

611.3.5 Common vertical vent offset. Where the common vertical vent is offset as shown in Figure 611.3D.2, the maximum common-vent capacity listed in the common venting tables shall be reduced by 20 percent (0.80 by maximum common-vent capacity), the equivalent of two 90-degree turns. The horizontal length of the common-vent offset (L_o) shall not exceed 1½ feet for each 1 inch of common-vent diameter (D).

611.3.6 Elbows in vents. Excluding elbows included in Subsection 611.3.5, for each additional 90-degree turn greater than two, the maximum capacity of that portion of the venting system shall be reduced by 10 percent (0.90 by maximum common-vent capacity).

Note: Two 45-degree turns are equivalent to one 90-degree turn.

611.3.7 Common vent minimum size. The minimum common-vent diameter shall be as large as the largest vent-connector diameter.

611.3.8 Common vent fittings. Interconnection fittings shall be the same size as the common vent.

611.3.9 Vent height measurement. For multiple units of gas utilization equipment all located on one floor, available total height (H) shall be measured from the highest draft hood outlet or flue collar up to the level of the cap or terminal. Connector rise (R) shall be measured from the draft hood outlet or flue collar to the level where the vent gas streams come together (not applicable to multiple-story installations).

611.3.10 Multiple-story height measurement. For multiple-story installations, available total height (H) for each segment of the system shall be the vertical distance between the highest draft hood outlet or flue collar entering that segment, and the centerline of the next higher interconnection tee. (See Figure 611.4A.)

611.3.11 Multiple-story lowest portion sizing. The size of the lowest connector and of the vertical vent leading to the lowest interconnection of a multiple-story system shall be in accordance with Table 611.2A or 611.2B for available total height (H) up to the lowest interconnection. (See Figure 611.4B.)

611.3.12 Multiple-story common vents. Where used in multiple-story systems, vertical common vents shall be Type B double-wall, and shall have no offsets.

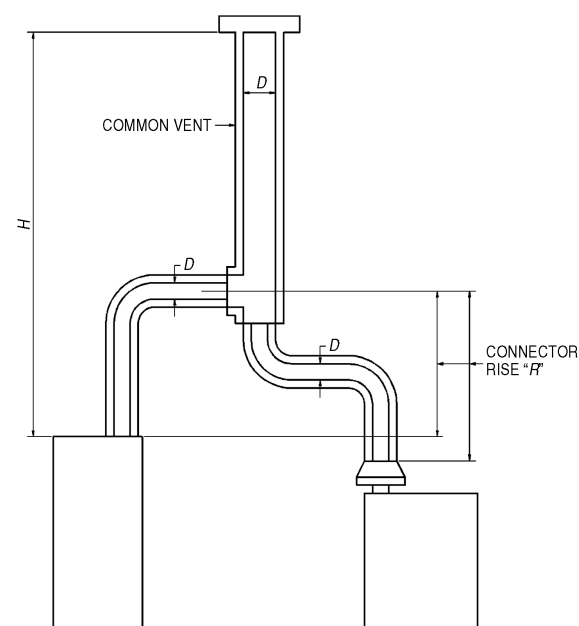


FIGURE 611.3A
TYPE B DOUBLE-WALL VENTS AND TYPE B DOUBLE-WALL CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
(SEE TABLES 611.3A.1 AND 611.3A.2)

Note: Each appliance may be either Category I draft-hood-equipped or fan-assisted type.

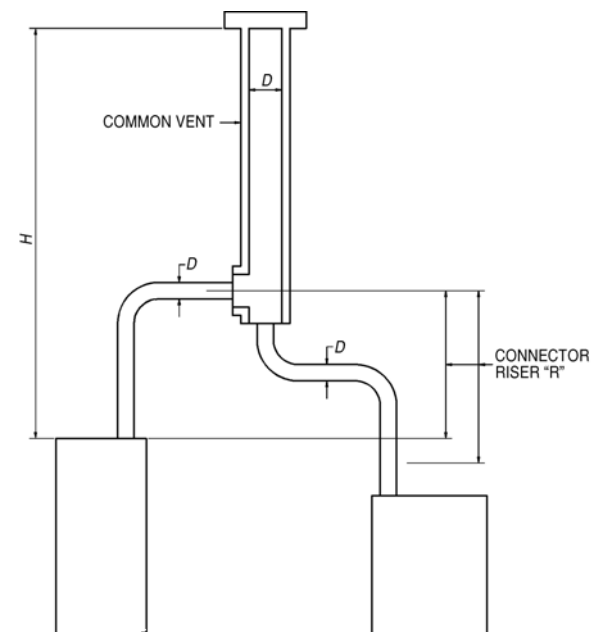


FIGURE 611.3B
TYPE B DOUBLE-WALL AND TYPE B SINGLE-WALL CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
(SEE TABLES 611.3B.1 AND 611.3B.2)

Note: Each appliance may be either Category I draft-hood-equipped or fan-assisted type.

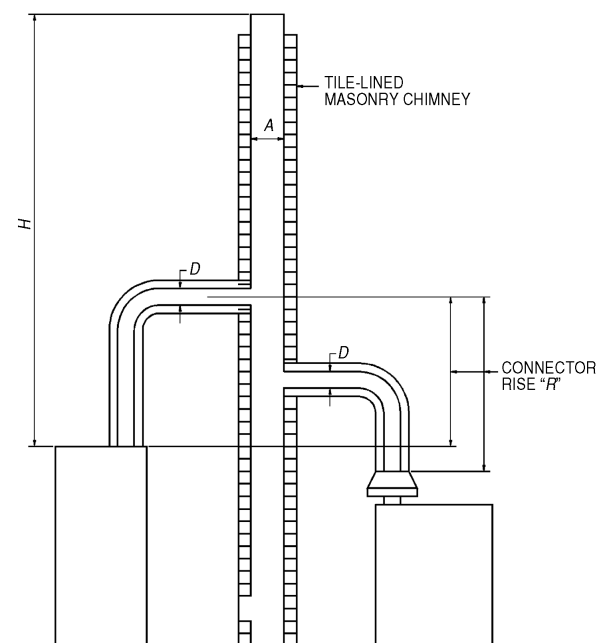


FIGURE 611.3C
MASONRY CHIMNEY AND TYPE B DOUBLE-WALL CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
(SEE TABLES 611.3C.1 AND 611.3C.2)

Note: Each appliance may be either Category I draft-hood-equipped or fan-assisted type.

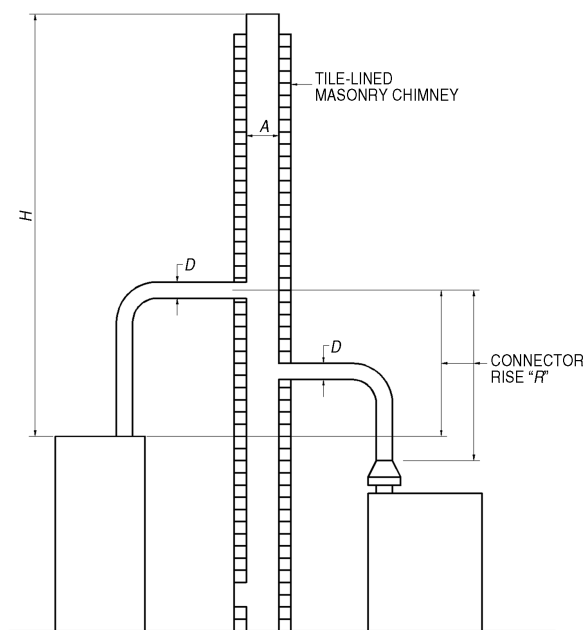


FIGURE 611.3D
MASONRY CHIMNEY AND SINGLE-WALL CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
(SEE TABLES 611.3B.1 AND 611.3B.2)

Note: Each appliance may be either Category I draft-hood-equipped or fan-assisted type.

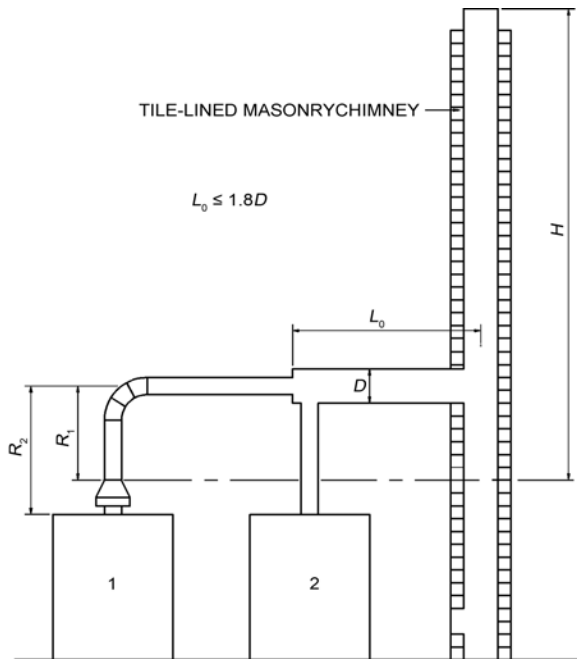


FIGURE 611.3D.1
MANIFOLDED COMMON-VENT CONNECTOR

Note: This is an illustration of a typical manifolded vent connector. Different appliance, vent connector or common-vent types are possible. Consult the notes for Tables 611.3A.1 through 611.3B.1 for common venting.

611.3.13 Vertical vent maximum size. Where two or more appliances are connected to a vertical vent or chimney, the flow area of the largest section of the vertical vent or chimney shall not exceed seven times the smallest listed appliance categorized vent areas, flue collar area or draft-hood-outlet area, unless designed in accordance with approved engineering methods.

611.3.14 Multiple input-rated appliances. For appliances with more than one input rating, the minimum vent-connector capacity (FAN Min) determined from these Tables shall not be less than the lowest appliance input rating, and the maximum vent-connector capacity (FAN Max or NAT Max) determined from these Tables shall be greater than the highest appliance input rating.

611.3.15 Liner system sizing and connectors. Listed, corrugated metallic, chimney liner systems in masonry chimneys shall be sized by using Tables 611.3A.1 and 611.3A.2, or 611.3B.1 and 611.3B.2 for Type B vents, with the maximum capacity reduced by 20 percent (0.80 by maximum capacity); and the minimum capacity as shown in Tables 611.3A.1 and 611.3A.2, or 611.3B.1 and 611.3B.2. Corrugated metal vent systems installed with bends or offsets require additional reduction of the vent maximum capacity.

611.3.16 Chimney and vent location. Tables 611.3A.1 through 611.3E.2 shall be used for chimneys and vents not exposed to the outdoors below the roof line. Chimneys or vents exposed to the outdoors below the roof line may experience continuous condensation, depending on their locality. Consult the appliance manufacturer, gas utility company or Chief Gas Inspector for approved locations. A

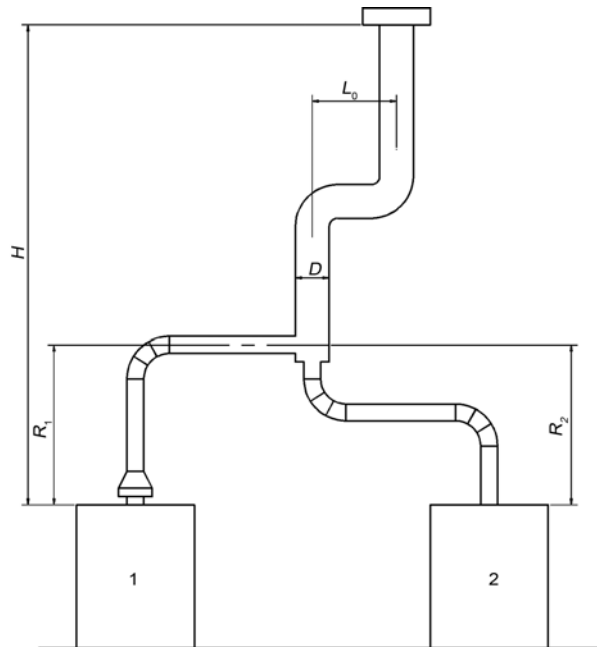


FIGURE 611.3D.2
OFFSET COMMON VENT

Note: This is an illustration of a typical offset vent. Different appliance, vent connector or vent types are possible. Consult the notes for Tables 611.3A.1 through 611.3B.1 for common venting.

Type B vent or listed chimney liner system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors.

611.3.17 Connector maximum and minimum size. Vent connectors shall not be upsized more than two sizes greater than the listed appliance-categorized vent diameter, flue collar diameter or draft-hood-outlet diameter. Vent connectors shall not be smaller than the listed appliance-categorized vent diameter, flue collar diameter or draft-hood-outlet diameter.

611.3.18 Component commingling. All combinations of pipe sizes, and single-wall and double-wall metal pipe shall be allowed within any connector run(s), or within the common vent, provided all of the appropriate tables permit all of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. If single-wall and Type B double-wall metal pipes are used for vent connectors, the common vent must be sized using Tables 611.3B.1 and 611.3B.2, or 611.3D.1 and 611.3D.2, as appropriate.

611.3.19 Multiple sizes permitted. Where a table permits more than one diameter of pipe to be used for a connector or vent, all the permitted sizes shall be permitted to be used.

Note: Use the smallest diameter permitted to minimize heat loss.

611.3.20 Table interpolation. Interpolation beyond these Table entries shall not be permitted. (See Appendix B.)

611.3.21 Extrapolation prohibited. Extrapolation beyond these Table entries shall not be permitted.

TABLE 611.3A.1
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
VENT-CONNECTOR CAPACITY

VENT HEIGHT <i>H</i> (feet)	CONNECTOR LATERAL <i>R</i> (feet)	TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER— <i>D</i> (inches)																									
		3		4			5			6			7			8			9			10					
		Appliance input rating limits in thousands of Btu/h																									
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289		
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345		
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386		
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303		
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358		
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402		
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314		
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372		
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417		
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333		
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394		
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444		
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347		
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414		
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	383	164	764	466		
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372		
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439		
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494		
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403		
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1,014	478		
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1,043	538		
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1,038	341	135	1,285	417		
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1,054	405	139	1,306	494		
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627	272	97	834	355	118	1,069	455	142	1,327	555		

(continued)

VENTING OF APPLIANCES

TABLE 611.3A.1—continued
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
VENT-CONNECTOR CAPACITY

VENT HEIGHT H (feet)	CONNECTOR LATERAL R (feet)	TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER—D (inches)																					
		12		14		16		18		20		22		24									
		Appliance input rating limits in thousands of Btu/h																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	
6	2	174	764	496	223	1,046	653	281	1,371	853	346	1,772	1,080	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	180	897	616	230	1,231	827	287	1,617	1,081	352	2,069	1,370	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	2	186	822	516	238	1,126	696	298	1,478	910	365	1,920	1,150	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	192	952	644	244	1,307	884	305	1,719	1,150	372	2,211	1,460	471	2,737	1,800	560	3,319	2,180	662	3,957	2,590	
	6	198	1050	772	252	1,445	1072	313	1,902	1,390	380	2,434	1,770	478	3,018	2,180	568	3,665	2,640	669	4,373	3,130	
10	2	196	870	536	249	1,195	730	311	1,570	955	379	2,049	1,205	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	201	997	664	256	1,371	924	318	1,804	1,205	387	2,332	1,535	486	2,887	1,890	581	3,502	2,280	686	4,175	2,710	
	6	207	1,095	792	263	1,509	1,118	325	1,989	1,455	395	2,556	1,865	494	3,169	2,290	589	3,849	2,760	694	4,593	3,270	
15	2	214	967	568	272	1,334	790	336	1,760	1,030	408	2,317	1,305	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	221	1,085	712	279	1,499	1,006	344	1,978	1,320	416	2,579	1,665	523	3,197	2,060	624	3,881	2,490	734	4,631	2,960	
	6	228	1,181	856	286	1,632	1,222	351	2,157	1,610	424	2,796	2,025	533	3,470	2,510	634	4,216	3,030	743	5,035	3,600	
20	2	223	1,051	596	291	1,443	840	357	1,911	1,095	430	2,533	1,385	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	230	1,162	748	298	1,597	1,064	365	2,116	1,395	438	2,778	1,765	554	3,447	2,180	661	4,190	2,630	772	5,005	3,130	
	6	237	1,253	900	307	1,726	1,288	373	2,287	1,695	450	2,984	2,145	567	3,708	2,650	671	4,511	3,190	785	5,392	3,790	
30	2	216	1,217	632	286	1,664	910	367	2,183	1,190	461	2,891	1,540	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	223	1,316	792	294	1,802	1,160	376	2,366	1,510	474	3,110	1,920	619	3,840	2,365	728	4,861	2,860	847	5,606	3,410	
	6	231	1,400	952	303	1,920	1,410	384	2,524	1,830	485	3,299	2,340	632	4,080	2,875	741	4,976	3,480	860	5,961	4,150	
50	2	206	1,479	689	273	2,023	1,007	350	2,659	1,315	435	3,548	1,665	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	213	1,561	860	281	2,139	1,291	359	2,814	1,685	447	3,730	2,135	580	4,601	2,633	709	5,569	3,185	851	6,633	3,790	
	6	221	1,631	1,031	290	2,242	1,575	369	2,951	2,055	461	3,893	2,605	594	4,808	3,208	724	5,826	3,885	867	6,943	4,620	
100	2	192	1,923	712	254	2,644	1,050	326	3,490	1,370	402	4,707	1,740	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	200	1,984	888	263	2,731	1,346	336	3,606	1,760	414	4,842	2,220	523	5,982	2,750	639	7,254	3,330	769	8,650	3,950	
	6	208	2,035	1,064	272	2,811	1,642	346	3,714	2,150	426	4,968	2,700	539	6,143	3,350	654	7,453	4,070	786	8,892	4,810	

TABLE 611.3A.2
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
COMMON VENT CAPACITY

VENT HEIGHT <i>H</i> (feet)	TYPE B DOUBLE-WALL COMMON VENT DIAMETER—D (inches)																				
	4			5			6			7			8			9			10		
	Combined appliance input rating in thousands of Btu/h																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1,035	826	640
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1,209	975	740
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1,164	977	705	1,451	1,188	860
100	175	163	NR	311	277	NR	489	421	NR	751	658	479	1,025	873	625	1,408	1,215	800	1,784	1,502	975

VENT HEIGHT <i>H</i> (feet)	TYPE B DOUBLE-WALL COMMON VENT DIAMETER— <i>D</i> (inches)																				
	12			14			16			18			20			22			24		
	Combined appliance input rating in thousands of Btu/h																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	900	696	588	1,284	990	815	1,735	1,336	1,065	2,263	1,732	1,345	2,838	2,180	1,660	3,488	2,677	1,970	4,206	3,226	2,390
8	994	773	652	1,423	1,103	912	1,927	1,491	1,190	2,507	1,936	1,510	3,162	2,439	1,860	3,890	2,998	2,200	4,695	3,616	2,680
10	1,076	841	712	1,542	1,200	995	2,093	1,625	1,300	2,727	2,113	1,645	3,444	2,665	2,030	4,241	3,278	2,400	5,123	3,957	2,920
15	1,247	986	825	1,794	1,410	1,158	2,440	1,910	1,510	3,184	2,484	1,910	4,026	3,133	2,360	4,971	3,862	2,790	6,016	4,670	3,400
20	1,405	1,116	916	2,006	1,588	1,290	2,722	2,147	1,690	3,561	2,798	2,140	4,548	3,552	2,640	5,573	4,352	3,120	6,749	5,261	3,800
30	1,658	1,327	1,025	2,373	1,892	1,525	3,220	2,558	1,990	4,197	3,326	2,520	5,303	4,193	3,110	6,539	5,157	3,680	7,940	6,247	4,480
50	2,024	1,640	1,280	2,911	2,347	1,863	3,964	3,183	2,430	5,184	4,149	3,075	6,567	5,240	3,800	8,116	6,458	4,500	9,837	7,813	5,475
100	2,569	2,131	1,670	3,732	3,076	2,450	5,125	4,202	3,200	6,749	5,509	4,050	8,597	6,986	5,000	10,681	8,648	5,920	13,004	10,499	7,200

TABLE 611.3B.1
CAPACITY OF TYPE B DOUBLE-WALL VENTS WITH SINGLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCE
VENT-CONNECTOR CAPACITY

VENT HEIGHT <i>H</i> (feet)	CONNECTOR RISE <i>R</i> (feet)	SINGLE-WALL METAL VENT CONNECTOR DIAMETER— <i>D</i> (inches)																									
		3			4			5			6			7			8			9			10				
		Appliance input rating in thousands of Btu/h																									
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	1	NR	NR	26	NR	NR	46	NR	NR	71	NR	NR	102	207	223	140	262	293	183	325	373	234	447	463	286		
	2	NR	NR	31	NR	NR	55	NR	NR	85	168	182	123	215	251	167	271	331	219	334	422	281	458	524	344		
	3	NR	NR	34	NR	NR	62	121	131	95	175	198	138	222	273	188	279	361	247	344	462	316	468	574	385		
8	1	NR	NR	27	NR	NR	48	NR	NR	75	NR	NR	106	226	240	145	285	316	191	352	403	244	481	502	299		
	2	NR	NR	32	NR	NR	57	125	126	89	184	193	127	234	266	173	293	353	228	360	450	292	492	560	355		
	3	NR	NR	35	NR	NR	64	130	138	100	191	208	144	241	287	197	302	381	256	370	489	328	501	609	400		
10	1	NR	NR	28	NR	NR	50	119	121	77	182	186	110	240	253	150	302	335	196	372	429	252	506	534	308		
	2	NR	NR	33	84	85	59	124	134	91	189	203	132	248	278	183	311	369	235	381	473	302	517	589	368		
	3	NR	NR	36	89	91	67	129	144	102	197	217	148	257	299	203	320	398	265	391	511	339	528	637	413		
15	1	NR	NR	29	79	87	52	116	138	81	177	214	116	238	291	158	312	380	208	397	482	266	556	596	324		
	2	NR	NR	34	83	94	62	121	150	97	185	230	138	246	314	189	321	411	248	407	522	317	568	646	387		
	3	NR	NR	39	87	100	70	127	160	109	193	243	157	255	333	215	331	438	281	418	557	360	579	690	437		
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325	165	306	425	217	390	538	276	546	664	336		
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346	197	317	453	259	400	574	331	558	709	403		
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363	223	326	476	294	412	607	375	570	750	457		
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380	175	296	497	230	378	630	294	528	779	358		
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397	208	307	521	274	389	662	349	541	819	425		
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235	316	542	309	400	690	394	555	855	482		
50	1	46	69	34	75	128	60	109	207	96	162	336	137	217	460	188	284	604	245	364	768	314	507	951	384		
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223	294	623	293	376	793	375	520	983	458		
	3	52	72	45	83	136	82	119	221	123	178	353	186	235	486	252	304	640	331	387	816	423	535	1,013	518		
100	1	45	79	34	71	150	61	104	249	98	153	424	140	205	585	192	269	774	249	345	993	321	476	1,236	393		
	2	48	80	41	75	153	73	110	255	115	160	428	167	212	593	228	279	788	299	358	1,011	383	490	1,259	469		
	3	51	81	46	79	157	85	114	260	129	168	433	190	222	603	256	289	801	339	368	1,027	431	506	1,280	527		

TABLE 611.3B.2
CAPACITY OF TYPE B DOUBLE-WALL VENT WITH SINGLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
COMMON-VENT CAPACITY

VENT HEIGHT <i>H</i> (feet)	TYPE B DOUBLE-WALL COMMON VENT DIAMETER— <i>D</i> (inches)																				
	4			5			6			7			8			9			10		
	Combined appliance input rating in thousands Of Btu/h																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	NR	78	64	NR	113	99	200	158	144	304	244	196	398	310	257	541	429	332	665	515	407
8	NR	87	71	NR	126	111	218	173	159	331	269	218	436	342	285	592	473	373	730	569	460
10	NR	94	76	163	137	120	237	189	174	357	292	236	467	369	309	638	512	398	787	617	487
15	121	108	88	189	159	140	275	221	200	416	343	274	544	434	357	738	599	456	905	718	553
20	131	118	98	208	177	156	305	247	223	463	383	302	606	487	395	824	673	512	1,013	808	626
30	145	132	113	236	202	180	350	286	257	533	446	349	703	570	459	958	790	593	1,183	952	723
50	159	145	128	268	233	208	406	337	296	622	529	410	833	686	535	1,139	954	689	1,418	1,157	838
100	166	153	NR	297	263	NR	469	398	NR	726	633	464	999	846	606	1,378	1,185	780	1,741	1,459	948

TABLE 611.3C.1
CAPACITY OF MASONRY CHIMNEY WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
VENT-CONNECTOR CAPACITY

VENT HEIGHT <i>H</i> (feet)	CONNECTOR RISE <i>R</i> (feet)	TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER— <i>D</i> (inches)																							
		3			4			5			6			7			8			9			10		
		Appliance input rating limits in thousands of Btu/h																							
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	24	33	21	39	62	40	52	106	67	65	194	101	87	274	141	104	370	201	124	479	253	145	599	319
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	173	107	436	232	127	562	300	148	694	378
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	203	109	491	270	129	633	349	151	795	439
8	1	24	39	22	39	72	41	55	117	69	71	213	105	94	304	148	113	414	210	134	539	267	156	682	335
	2	26	47	29	40	87	53	57	140	86	73	246	127	97	350	179	116	473	240	137	615	311	160	776	394
	3	27	52	34	42	97	62	59	159	98	75	269	145	99	383	206	119	517	276	139	672	358	163	848	452
10	1	24	42	22	38	80	42	55	130	71	74	232	108	101	324	153	120	444	216	142	582	277	165	739	348
	2	26	50	29	40	93	54	57	153	87	76	261	129	103	366	184	123	498	247	145	652	321	168	825	407
	3	27	55	35	41	105	63	58	170	100	78	284	148	106	397	209	126	540	281	147	705	366	171	893	463
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	164	125	511	229	153	658	297	184	824	375
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	192	128	558	260	156	718	339	187	900	432
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	215	131	597	292	159	760	382	190	960	486
20	1	24	52	24	37	102	46	53	172	77	71	313	119	98	437	173	123	584	239	150	752	312	180	943	397
	2	25	58	31	39	114	56	55	190	91	73	335	138	101	467	199	126	625	270	153	805	354	184	1,011	452
	3	26	63	35	40	123	65	57	204	104	75	353	157	104	493	222	129	661	301	156	851	396	187	1,067	505
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	187	119	680	255	145	883	337	175	1,115	432
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	209	122	715	287	149	928	378	179	1,171	484
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	233	125	746	317	152	968	418	182	1,220	535
50	1	23	51	25	36	116	51	51	209	89	67	405	143	92	582	213	115	798	294	140	1,049	392	168	1,334	506
	2	24	59	32	37	127	61	53	225	102	70	421	161	95	604	235	118	827	326	143	1,085	433	172	1,379	558
	3	26	64	36	39	135	69	55	237	115	72	435	180	98	624	260	121	854	357	147	1,118	474	176	1,421	611
100	1	23	46	25	35	108	50	49	208	92	65	428	155	88	640	237	109	907	334	134	222	454	161	1,589	596
	2	24	53	31	37	120	60	51	224	105	67	444	174	92	660	260	113	933	368	138	1,253	497	165	1,626	651
	3	25	59	35	38	130	68	53	237	118	69	458	193	94	679	285	116	956	399	141	1,282	540	169	1,661	705

TABLE 611.3C.2
CAPACITY OF MASONRY CHIMNEY WITH TYPE B DOUBLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
COMMON CHIMNEY CAPACITY

VENT HEIGHT <i>H</i> (feet)	MINIMUM INTERNAL AREA OF MASONRY CHIMNEY FLUE (square inches)																							
	12			19			28			38			50			63			78			113		
	Combined appliance input rating In thousands of Btu/h																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	NR	74	25	NR	119	46	NR	178	71	NR	257	103	NR	351	143	NR	458	188	NR	582	246	1,041	853	NR
8	NR	80	28	NR	130	53	NR	193	82	NR	279	119	NR	384	163	NR	501	218	724	636	278	1,144	937	408
10	NR	84	31	NR	138	56	NR	207	90	NR	299	131	NR	409	177	606	538	236	776	686	302	1,226	1,010	454
15	NR	NR	36	NR	152	67	NR	233	106	NR	334	152	523	467	212	682	611	283	874	781	365	1,374	1,156	546
20	NR	NR	41	NR	NR	75	NR	250	122	NR	368	172	565	508	243	742	668	325	955	858	419	1,513	1,286	648
30	NR	NR	NR	NR	NR	NR	NR	270	137	NR	404	198	615	564	278	816	747	381	1,062	969	496	1,702	1,473	749
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	620	328	879	831	461	1,165	1,089	606	1,905	1,692	922
100	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	348	NR	NR	499	NR	NR	699	2,053	1,921	1,058

VENTING OF APPLIANCES

TABLE 611.3D.1
CAPACITY OF MASONRY CHIMNEY WITH SINGLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
VENT CONNECTOR CAPACITY

VENT HEIGHT H (feet)	CONNECTOR RISE R (feet)	SINGLE-WALL METAL VENT CONNECTOR DIAMETER—D (inches)																									
		3		4		5		6		7		8		9		10											
		Appliance input rating limits in thousands of Btu/h																									
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	1	NR	NR	21	NR	NR	39	NR	NR	66	179	191	100	231	271	140	292	366	200	362	474	252	499	594	316		
	2	NR	NR	28	NR	NR	52	NR	NR	84	186	227	123	239	321	172	301	432	231	373	557	299	509	696	376		
	3	NR	NR	34	NR	NR	61	134	153	97	193	258	142	247	365	202	309	491	269	381	634	348	519	793	437		
8	1	NR	NR	21	NR	NR	40	NR	NR	68	195	208	103	250	298	146	313	407	207	387	530	263	529	672	331		
	2	NR	NR	28	NR	NR	52	137	139	85	202	240	125	258	343	177	323	465	238	397	607	309	540	766	391		
	3	NR	NR	34	NR	NR	62	143	156	98	210	264	145	266	376	205	332	509	274	407	663	356	551	838	450		
10	1	NR	NR	22	NR	NR	41	130	151	70	202	225	106	267	316	151	333	434	213	410	571	273	558	727	343		
	2	NR	NR	29	NR	NR	53	136	150	86	210	255	138	276	358	181	343	489	244	420	640	317	569	813	403		
	3	NR	NR	34	97	102	62	143	166	99	217	277	147	284	389	207	352	530	279	430	694	363	580	880	459		
15	1	NR	NR	23	NR	NR	43	129	151	73	199	271	112	268	376	161	349	502	225	445	646	291	623	808	366		
	2	NR	NR	30	92	103	54	135	170	88	207	295	132	277	411	189	359	548	256	456	706	334	634	884	424		
	3	NR	NR	34	96	112	63	141	185	101	215	315	151	286	439	213	368	586	289	466	755	378	646	945	479		
20	1	NR	NR	23	87	99	45	128	167	76	197	303	117	265	425	169	345	569	235	439	734	306	614	921	387		
	2	NR	NR	30	91	111	55	134	185	90	205	325	136	274	455	195	355	610	266	450	787	348	627	986	443		
	3	NR	NR	35	96	119	64	140	199	103	213	343	154	282	481	219	365	644	298	461	831	391	639	1,042	496		
30	1	NR	NR	24	86	108	47	126	187	80	193	347	124	259	492	183	338	665	250	430	864	330	600	1,089	421		
	2	NR	NR	31	91	119	57	132	203	93	201	366	142	269	518	205	348	699	282	442	908	372	613	1,145	473		
	3	NR	NR	35	95	127	65	138	216	105	209	381	160	277	540	229	358	729	312	452	946	412	626	1,193	524		
50	1	NR	NR	24	85	113	50	124	204	87	188	392	139	252	567	208	328	778	287	417	1,022	383	582	1,302	492		
	2	NR	NR	31	89	123	60	130	218	100	196	408	158	262	588	230	339	806	320	429	1,058	425	596	1,346	545		
	3	NR	NR	35	94	131	68	136	231	112	205	422	176	271	607	255	349	831	351	440	1,090	466	610	1,386	597		
100	1	NR	NR	23	84	104	49	122	200	89	182	410	151	243	617	232	315	875	328	402	1,181	444	560	1,537	580		
	2	NR	NR	30	88	115	59	127	215	102	190	425	169	253	636	254	326	899	361	415	1,210	488	575	1,570	634		
	3	NR	NR	34	93	124	67	133	228	115	199	438	188	262	654	279	337	921	392	427	1,238	529	589	1,604	687		

TABLE 611.3D.2
CAPACITY OF MASONRY CHIMNEY WITH SINGLE-WALL
CONNECTORS SERVING TWO OR MORE CATEGORY I APPLIANCES
COMMON CHIMNEY CAPACITY

VENT HEIGHT H (feet)	MINIMUM INTERVAL AREA OF MASONRY CHIMNEY FLUE (square inches)																							
	12			19			28			38			50			63			78			113		
	Combined appliance input rating in thousands Of Btu/h																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	NR	NR	25	NR	118	45	NR	176	71	NR	255	102	NR	348	142	NR	455	187	NR	579	245	NR	846	NR
8	NR	NR	28	NR	128	52	NR	190	81	NR	276	118	NR	380	162	NR	497	217	NR	633	277	1,136	928	405
10	NR	NR	31	NR	136	56	NR	205	89	NR	295	129	NR	405	175	NR	532	234	771	680	300	1,216	1,000	450
15	NR	NR	36	NR	NR	66	NR	230	105	NR	335	150	NR	400	210	677	602	280	866	772	360	1,359	1,139	540
20	NR	NR	NR	NR	NR	74	NR	247	120	NR	362	170	NR	503	240	765	661	321	947	849	415	1,495	1,264	640
30	NR	NR	NR	NR	NR	NR	NR	NR	135	NR	398	195	NR	558	275	808	739	377	1,052	957	490	1,682	1,447	740
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	612	325	NR	821	456	1,152	1,076	600	1,879	1,672	910
100	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	494	NR	NR	663	2,006	1,885	1,046

TABLE 611.3E.1
CAPACITY OF SINGLE-WALL METAL PIPE

TOTAL VENT HEIGHT <i>H</i> (feet)	CONNECTOR RISE <i>R</i> (feet)	VENT CONNECTOR DIAMETER— <i>D</i> (inches)					
		3	4	5	6	7	8
		Maximum appliance input rating in thousands of Btu/h					
6 – 8	1	21	40	68	102	146	205
	2	28	53	86	124	178	235
	3	34	61	98	147	204	275
15	1	23	44	77	117	179	240
	2	30	56	92	134	194	265
	3	35	64	102	155	216	298
30 and greater	1	25	49	84	129	190	270
	2	31	58	97	145	211	295
	3	36	68	107	164	232	321

TABLE 611.3E.2
CAPACITY OF SINGLE-WALL METAL PIPE

TOTAL HEIGHT <i>H</i> (feet)	COMMON VENT DIAMETER— <i>D</i> (inches)						
	4	5	6	7	8	10	12
	Combined appliance input rating in thousands of Btu/h						
6	48	78	111	155	205	320	NR
8	55	89	128	175	234	365	505
10	59	95	136	190	250	395	560
15	71	115	168	228	305	480	690
20	80	129	186	260	340	550	790
30	NR	147	215	300	400	650	940
50	NR	NR	NR	360	490	810	1,190

See Figure 611.3A and Notes for Multiple-Appliance Vents.

**TABLE 611.3F
MASONRY CHIMNEY LINER DIMENSIONS WITH CIRCULAR EQUIVALENTS**

NOMINAL LINER SIZE (Inches)	INSIDE DIMENSIONS OF LINER (Inches)	INSIDE DIAMETER OR EQUIVALENT DIAMETER (Inches)	EQUIVALENT AREA (square inches)
4 × 8	2½ × 6½	4	12.2
		5	19.6
		6	28.3
		7	38.3
8 × 8	6¾ × 6¾	7.4	42.7
		8	50.3
8 × 12	6½ × 10½	9	63.6
		10	78.5
12 × 12	9¾ × 9¾	10.4	83.3
		11	95
12 × 16	9½ × 13½	11.8	107.5
		12	113.0
		14	153.9
16 × 16	13¼ × 13¼	14.5	162.9
		15	176.7
16 × 20	13 × 17	16.2	206.1
		18	254.4
20 × 20	16¾ × 16¾	18.2	260.2
		20	314.1
20 × 24	16½ × 20½	20.1	314.2
		22	380.1
24 × 24	20¼ × 20¼	22.1	380.1
		24	452.3
24 × 28	20¼ × 24¼	24.1	456.2
		26.4	543.3
28 × 28	24¼ × 24¼	27	572.5
		27.9	607
30 × 30	25¼ × 25½	30	706.8
		30.9	749.9
30 × 36	25½ × 31½	33	855.3
		34.4	929.4
36 × 36	31½ × 31½	36	1,017.9

Note: When liner sizes differ dimensionally from those shown in this Table, equivalent diameters may be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.

611.4 Multiple-story venting. Common-venting systems for appliances on more than one floor (multiple-story) shall be sized and constructed in accordance with approved engineering methods, such as those outlined in Subsection 611.3 and Tables 611.3A.1 through 611.3F, provided that:

- (a) The least total vent height (H) for each segment is taken as the vertical distance between the inlet of the

highest flue collar on that floor and the centerline of the next interconnection tee; and

- (b) The flow through each segment is the total flow of that segment and all flue gas flow from upstream appliances. (See Figures 611.4A and 611.4B.)

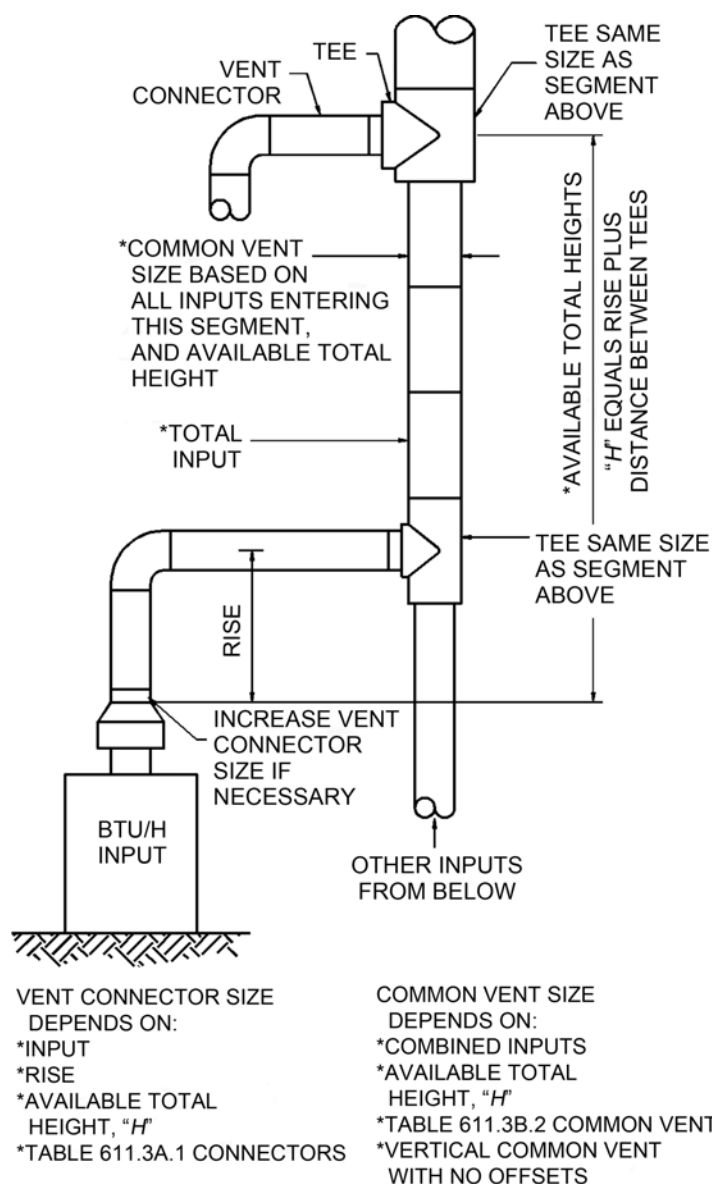


FIGURE 611.4A
MULTIPLE-STORY GAS VENT DESIGN PROCEDURE FOR EACH SEGMENT OF SYSTEM

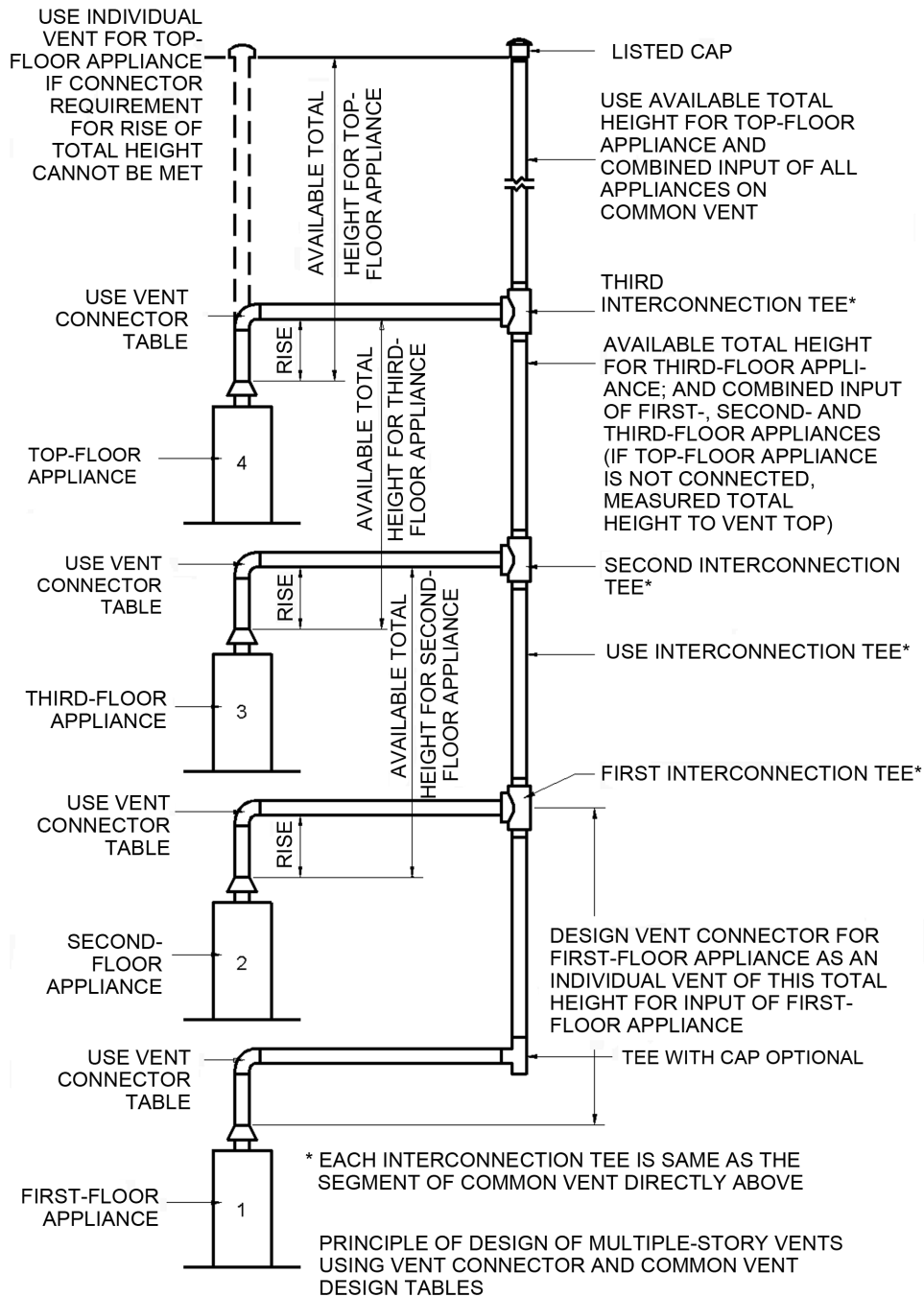


FIGURE 611.4B
MULTIPLE-STORY VENT SYSTEMS

SECTION 612 SIZING OF CATEGORY II, III AND IV APPLIANCE VENTING SYSTEMS

612.1 General. The sizing of gas vents for Category II, III, and IV gas utilization equipment shall be in accordance with the equipment manufacturer's installation instructions.

CHAPTER 7

PLACING AN APPLIANCE IN OPERATION

SECTION 701 GENERAL

701.1 Fundamental procedures. This Chapter provides the fundamental procedures to be followed when placing an appliance in operation. The installing agency shall be responsible for complying with these requirements.

SECTION 702 ADJUSTING BURNER INPUT

702.1 Required input. Each burner shall be adjusted to its required input in accordance with the manufacturer's installation instructions. Burners that are over rated are prohibited.

SECTION 703 PRIMARY AIR ADJUSTMENT

703.1 Injection-type burners. The primary air used in injection-type (Bunsen) burners shall be adjusted to control the flame in accordance with the manufacturer's installation instructions. The primary air adjustment shall be set initially to produce a blue flame with yellow-flamed tips; then, through adjustment, an increase in the primary air will cause the yellow tips to dissipate leaving a steady blue flame. When the primary air setting is complete, the adjustment means shall be secured in position. Consult the manufacturer or gas utility company if, through this process, the burner does not produce these results.

SECTION 704 SAFETY SHUTOFF DEVICE

704.1 Inspection required. When a safety shutoff device is provided, it shall be inspected for proper operation and adjustment in accordance with the manufacturer's installation instructions. If the device does not cut off the gas supply in the event of a pilot outage according to the manufacturer's requirements, it shall be repaired or replaced.

SECTION 705 PROTECTIVE DEVICES

705.1 Proper operation. All protection devices furnished with appliances, such as a limit controls, fan controls for blowers, temperature and pressure relief valves, low-water cutoff devices and manual operating features, shall be inspected to ensure their proper operation.

SECTION 706 CHECKING DRAFT

706.1 Match or taper test. Vent-connected appliances shall operate according to the manufacturer's requirements. Appliances shall be inspected to ensure the products of combustion

are released through vents according to their operating requirements.

A lit match or taper shall be held around the edge of the relief opening of the draft hood to confirm the products of combustion are being properly removed. The removal of the products of combustion shall be confirmed if the flame is drawn into the draft hood; if the products of combustion are not being vented properly, they may extinguish the flame or spill out from underneath the draft hood.

If the products of combustion are proven, through the match test, to be escaping from the relief opening of the draft hood, the appliance shall not be allowed to operate until adjustments or repairs have been made to ensure adequate draft through the vent.

SECTION 707 OPERATING INSTRUCTIONS

707.1 Provided to the owner. When operating instructions are furnished by the manufacturer, they shall be left with the owner or with the appliance.

SECTION 708 AUTOMATIC IGNITION

708.1 Proper operation verification. Gas appliances supplied with a control for automatic ignition shall be inspected for proper operation in accordance with the manufacturer's installation instructions.

SECTION 709 CARBON MONOXIDE PROTECTION

709.1 Carbon monoxide protection. See Subsection 503.13 in the *EPCOT Building Code*.

CHAPTER 8

GAS EQUIPMENT IN UNLISTED BOILERS

SECTION 801 SCOPE

801.1 General. This Chapter provides the minimum safety requirements for the installation of gas equipment in unlisted boilers having an input greater than 400,000 Btu per hour (Btu/h); having a working pressure of not greater than 15 pounds per square inch (psi); and furnishing steam, hot water or both for heating and water heating. Where conditions exist that are not specifically covered by these minimum safety requirements, the Chief Gas Inspector shall provide the requirements for the installation method.

SECTION 802 COMBUSTION AIR

802.1 Minimum requirements. Properly designed permanent methods for supplying an ample amount of outside air to assure combustion of the gas shall be provided. Where combustion air is taken from the space in which the boiler is located and manufacturer's instructions are not available, an opening to the outside air shall be provided having a net free area of $3/4$ square feet or more for each 1,000,000 Btu/h of the total burner input, or an opening equivalent to the total area of the stacks that are being used, whichever is greater. These provisions only apply to boilers in which the products of combustion are undiluted in the flue or vent connector. When draft diverters, check drafts, fixed check openings, barometric dampers or a boiler room ventilating system are used, additional openings shall be provided for adequate air infiltration without affecting the combustion in the firebox.

SECTION 803 VENTILATION

803.1 Adequate ventilation required. Adequate ventilation of the boiler room shall be provided. The ventilation system shall not adversely affect the combustion of gas in the boiler.

SECTION 804 VENTS AND VENT CONNECTORS

804.1 Size. All boilers shall be properly and firmly connected to a chimney or stack of a size required by the manufacturer to carry away the flue gases. The vent connector shall not be smaller than the outlet on the boiler.

804.2 Draft limits. Means for limiting draft shall be installed on each boiler. When a manually operated damper is used in a normally stationary position to limit chimney draft, a positive means or method shall be provided to lock the damper in position. The manually operated damper shall be installed between the boiler and any application of automatic or modulating draft-limiting devices.

804.3 Damper interlock. When an automatically controlled or modulating damper is used with the burner control assembly,

this damper shall be interlocked with the burner input control valve to prevent the lighting of the burner unless the damper is open.

804.4 Operating stops. Adjustable (modulating) dampers, where used for fuel-air ratio control, shall be equipped with the maximum and minimum operating stops. The minimum operating stops for such dampers shall be located to ensure the combustion of the gas at minimum burner input. These dampers shall be counterbalanced to open in the event of breakage or failure of their operating means.

SECTION 805 BURNERS

805.1 Installation. Burners and their component parts shall be installed and secured in accordance with the burner manufacturer's installation instructions. Burners must be installed in such a manner as to permit their being withdrawn for repairs or alterations without disturbing the furnace walls or settings. Weight of the walls must not rest on horizontal burners.

805.2 Combustion stability.

805.2.1 Gas integrity. The gas must be burned in such a manner throughout the range of turndown so there will be no puffing, vibration, flame lifting, backfiring or injurious flame impingement on the walls or heating surfaces in a manner that will cause damage to the boiler parts.

805.2.2 Stable combustion. Burners shall also maintain stable combustion at the minimum rate of firing or during any sudden change in the gas-firing rate between maximum and minimum rates.

SECTION 806 AIR INTAKES

806.1 Introduction of air. Air openings into the combustion chamber or firebox shall be provided with the area required to supply the amount of air for combustion under the actual draft conditions existing at the maximum rate of firing. The air shall be introduced in a manner so as to obtain thorough mixing of the gas and air in order to ensure combustion within the space provided.

806.2 Draft. For manually or automatically controlled boilers having forced or induced draft fan, or both, means shall be provided to continue safe combustion or to shut off the gas in case of draft failure for any cause. Forced or induced draft installations shall be provided with a mechanical timer to require a 5-minute purge period prior to the pilot ignition after shut down. This purge period may be reduced as long as sufficient time is assured to provide for complete purging of the firebox and flue passages prior to the pilot ignition after shut down. A spark or ignition shall not be allowed to occur in the firebox during the purging cycle.

SECTION 807 PILOTS

807.1 Positive ignition. An adequate gas pilot shall be used to ensure the positive ignition of the burner.

807.2 Shutoff device.

807.2.1 Flame failure. A safety shutoff device or flame safeguard, so constructed and installed that no gas can flow to the main burner or burner group unless ignition is ensured, shall be employed at each burner or group of burners operating as a unit, for all automatically controlled boilers. Gas-to-main burners and intermittent or ignition pilots shall be automatically shut off in case of flame failure at the point of supervision.

807.2.2 Response time. The response time of the flame safeguard to de-energize the safety shutoff device for flame failure shall not exceed 5 seconds for unlisted boilers having inputs in excess of 400,000 Btu/h. Pilot supervision by such safety shutoff device shall be only at the point where the flame will ignite the gas at the main burner.

807.3 Electric ignition. Electric ignition systems shall ignite only a pilot. The input to the pilot shall not exceed 3 percent of the maximum input to the main burner as fired. If ignition of the pilot is not obtained within 15 seconds, the gas shall shut off automatically.

807.4 Support. All pilot burners and safety shutoff devices shall be supported in such a manner that their position, relative to each other and to the flame of the burners, will remain fixed. Means shall be provided to permit the observation of all three while firing. Wiring or controls shall not be subjected to the heat from the burners, unless they are specifically designed to withstand such temperatures.

807.5 Accessibility. All pilot burners and safety shutoff devices shall be readily accessible and removable for servicing. Pilot burners shall be placed so that they can be safely lighted manually, if required. Where push-button controls are used for manually opening pilot solenoid valves, they shall be installed so one operator can light the pilot and operate the push button simultaneously.

807.6 Pressure regulator. On automatically controlled boilers, the gas supply pressure to the pilot shall be regulated independently of the main burner supply by a gas pressure regulator in the pilot supply line.

807.7 Connection. Pilot lines shall be connected to vertical main gas supply pipes, or to the sides or top of horizontal lines upstream from all gas control valves, and they shall be independently controlled by a manually operated pilot shutoff valve. For installations requiring more than one pilot, a manually operated shutoff valve shall be provided for each pilot.

SECTION 808 CONTROLS

808.1 Manual shutoff valves.

808.1.1 Lubricated plug type. Each boiler burner assembly shall have a lubricated plug-type shutoff valve with a

handle permanently attached that will shut off the gas to the burner and control valve assembly.

808.1.2 Manually controlled firing rate. If the firing rate of the burner is controlled manually, each burner shall have a separate firing valve designed for the maximum operating gas pressure on the burner.

808.2 Control valves.

808.2.1 Downstream location. All boiler input control valves and safety shutoff valves shall be installed downstream from the shutoff valves described in Subsection 808.1.1.

808.2.2 Bypass valve. A bypass may be installed around a throttling-type burner input control valve to provide for a minimum flame. When such a bypass or minimum flow setting is used with a burner input control valve, a separate safety shutoff valve shall be installed to shut off the gas supply when the limit or protective controls are actuated.

808.2.3 Electrically operated safety shutoff valves. Electrically operated safety shutoff valves shall not depend on electricity to shut off the gas supply. All vents from any control valve actuated by gas pressure shall be piped into the firebox adjacent to a constantly burning pilot or to a safe point outside the building. Iron or steel pipe or tubing shall be used for venting the valve.

808.3 Gas pressure regulators.

808.3.1 When required. Where the gas supply pressure to the burner is higher than that at which the burners normally operate on a particular installation, a gas pressure regulator shall be used.

808.3.2 Regulator types. Regulators shall be of the spring-loaded, dead-weight or pressure-balanced type, and they shall maintain a gas pressure within 10 percent of the operating pressure from the maximum to minimum firing rates. The weight and lever type of regulator shall not be used.

808.3.3 Venting. Pressure regulators shall be vented:

- Into the furnace adjacent to a constantly burning pilot;
- Into the stack above the damper as far removed from the burner as possible; or
- To a safe point outside of the building. Iron or steel pipe or tubing shall be used for venting the regulator.

808.4 Indicating pressure gage connections. A connection shall be provided to attach a gage to indicate the gas pressure on the burner.

808.5 Limiting devices.

808.5.1 Excessive pressures or temperatures. Automatically controlled burners to boilers shall be equipped with safety devices arranged to prevent excessive pressures or temperatures by shutting off the gas.

808.5.2 Low water. Low-water cutoffs shall be used on all automatically controlled steam boilers.

CHAPTER 9

INSTALLATION REQUIREMENTS FOR UNDILUTED LIQUEFIED PETROLEUM GASES (BUTANE AND PROPANE)

SECTION 901 GENERAL

901.1 Undiluted LP gas. This Chapter provides the specific requirements for the installation of gas piping and appliances where undiluted liquefied petroleum gas (LP gas) is used. The provisions of Chapters 1 through 8 are applicable to undiluted LP-gas gas installations, except as modified in this Chapter.

SECTION 902 PIPING

902.1 Piping material.

902.1.1 Building piping. A yard line or building piping used with LP gases shall be steel or wrought-iron piping complying with ASME B36.10; brass or copper piping; or seamless copper, brass or steel tubing. Copper tubing shall be of the standard Grade K or L, or equivalent, complying with the ASTM B88 or ASTM B280. Steel tubing shall comply with ASTM A539. Plastic piping and tubing complying with ASTM D2513, and plastic fittings complying with ASTM D2683 or ASTM D3261, may be used outside, underground only.

902.1.2 Minimum working pressure. All piping or tubing shall be suitable for a working pressure of not less than 125 pounds per square inch (psi).

902.2 Joints.

902.2.1 Piping. Piping joints may be screwed, flanged, welded or brazed with a material having a melting point exceeding 1,000°F. Fittings shall be designed for a pressure of at least 125 psi. Cast-iron fittings shall be prohibited.

902.2.2 Seamless. Joints of seamless copper, brass, steel or nonferrous gas tubing shall be made by means of flared gas tubing fittings, or brazed with a material having a melting point exceeding 1,000°F. Compression-type tube fittings shall not be used.

902.3 Size of pipe or tubing. The Btu content and specific gravity of undiluted LP gases are such that the provisions of Subsection 305.1 are not applicable. Piping sizes may be calculated by one of the following procedures:

1. As specified in Subsections 305.4 and 305.5, except substitute Table 902.3A for Table 305.4A, and Table 902.3B for Table 305.4B.
2. As specified in Subsections 305.3 and 305.4 with the following modifications:

Sizing shall be determined as though the type of gas to be used was 1,000 Btu, 0.60 specific gravity. The

size of the piping obtained may be reduced to the size of piping or tubing listed in Table 902.3C, which compensates for the difference in gases.

3. As specified in Subsection 305.5.

**TABLE 902.3A
CAPACITY OF SCHEDULE 40 PIPE
THOUSANDS OF BTU PER HOUR
OF UNDILUTED LP GAS**

AT A PRESSURE DROP OF 1/2-INCH WATER COLUMN

LENGTH OF PIPE (feet)	NOMINAL PIPE DIAMETER (inches)					
	1/2	3/4	1	1 1/4	1 1/2	2
10	275	567	1,071	2,205	3,307	6,221
20	189	393	732	1,496	2,299	4,331
30	152	315	590	1,212	1,858	3,465
40	129	267	504	1,039	1,559	2,992
50	114	237	448	913	1,417	2,646
60	103	217	409	834	1,275	2,394
70	96	196	378	771	1,181	2,205
80	89	185	346	724	1,086	2,047
90	83	173	322	677	1,023	1,921
100	78	162	307	630	976	1,811
125	69	146	275	567	866	1,606
150	63	132	252	511	787	1,496

**TABLE 902.3B
CAPACITY OF SEMIRIGID TUBING
THOUSANDS OF BTU PER HOUR OF UNDILUTED
LP GAS AT A PRESSURE DROP OF 1/2-INCH WATER COLUMN**

LENGTH OF TUBING (feet)	OUTSIDE DIAMETER (inches)				
	3/8	1/2	5/8	3/4	7/8
10	39	92	199	329	501
20	26	62	131	216	346
30	21	50	107	181	277
40	19	41	90	145	233
50	—	37	79	131	198
60	—	35	72	121	187
70	—	31	67	112	164
80	—	29	62	104	155
90	—	27	59	95	146
100	—	27	55	90	138

TABLE 902.3C
CORRESPONDING SIZES
SUITABLE FOR UNDILUTED LP GASES BASED
ON SIZES REQUIRED FOR NATURAL GAS

SIZE REQUIRED FOR 1000 BTU 0.60 NATURAL GAS IRON PIPE (nom. dia. in)	CORRESPONDING SIZES SUITABLE FOR UNDILUTED LP GASES	
	Iron Pipe (nom. dia. in)	Copper Tubing OD (inches)
1/2	3/8	5/8
3/4	1/2	3/4
1	3/4	7/8
1 1/4	1	1 1/8
1 1/2	1 1/4	1 3/8
2	1 1/2	1 5/8
2 1/2	2	2 1/8
3	2 1/2	—
4	3	—
6	6	—

902.4 Tubing in partitions. This provision shall not apply to tubing that pierces walls, floors or partitions. Tubing shall be permitted to be installed vertically and horizontally inside hollow walls or partitions without protection along its entire concealed length, provided:

- (a) A steel striker barrier not less than 0.0508 inch thick, or equivalent, is installed between the tubing and the finished wall, and extends at least 4 inches beyond the concealed penetrations of the plates, firestops, wall studs, etc., and
- (b) The tubing is installed in single runs and is not rigidly secured.

SECTION 903

SPECIAL PROVISIONS

903.1 Appliance regulators. When regulators are used with LP appliances, they shall be listed for such use and installed in accordance with their listing.

903.2 Safety shutoff devices. Manually controlled water heaters and automatically controlled appliances, except domestic ranges and commercial cooking equipment having pilot input ratings of 500 Btu per hour or less, for use with undiluted LP gases, shall be equipped with safety shutoff devices of the complete shutoff type.

CHAPTER 10

TWO-PSI GAS PIPING

SECTION 1001 GENERAL

1001.1 Scope and responsibility. This Chapter provides additional fundamental requirements for the installation of consumers' gas piping systems using a 2-pound-per-square-inch (psi) gas pressure. The installing agency shall be responsible for complying with these requirements.

1001.2 Requirements. The requirements of Chapters 1 through 7, except for Subsections 305.1, 305.2 and 305.4, are applicable to 2-psi gas piping installations, except as such requirements are modified in this Chapter.

1001.3 2-psi piping system. Two-psi gas piping systems, designed in accordance with this Chapter and other requirements of this Code, are intended for use where the building service regulator has been set to deliver gas at 2 psi.

SECTION 1002 REQUIRED GAS SUPPLY

1002.1 Hourly volume. The hourly volume of gas required at each outlet shall be determined in accordance with Subsection 305.3.

SECTION 1003 REQUIRED SIZE OF GAS PIPING

1003.1 Required size for 2-psi piping. To determine the size of consumers' gas piping from point of delivery to consumer's MP regulators when the gas is 2 psi, proceed as follows:

- (a) Measure the length of piping from the point where the building piping begins to the most remote consumers' MP regulator. (See Chapter 2 for the definition of "Building piping.")
- (b) In the first vertical column in Table 1003A, select the horizontal line showing the distance or the next longer distance if the Table does not give the exact length.
- (c) Use this horizontal line to locate all gas demand figures for this particular system of gas piping.
- (d) Starting at the most remote consumers' MP regulator, find, in the horizontal line just selected, the gas demand for that regulator. If the text figure of demand is not shown, choose the next larger figure to the right on the same line.
- (e) Above this demand figure in the top horizontal line in Table 1003A will be the nominal size of piping required.
- (f) For each succeeding section of pipe, determine the total gas demand supplied by such section and then proceed in accordance with the previously outlined provisions to determine the size of each section of piping.

- (g) For cast-iron pipe, follow the foregoing procedure using Table 1003C.

**TABLE 1003A
SIZE OF GAS TUBING
MAXIMUM CAPACITY OF TUBING IN CUBIC FEET OF GAS PER
HOUR BASED ON A PRESSURE DROP OF 1¹/₂ PSI AND 0.6
SPECIFIC GRAVITY GAS**

LENGTH (feet)	OUTSIDE DIAMETER OF TUBING (inch)			
	3/8	1/2	5/8	7/8
5	501	1,062	2,222	5,706
10	336	713	1,491	3,831
15	266	565	1,181	3,034
20	226	479	1,001	2,571
30	179	379	793	2,037
40	151	321	672	1,726
50	133	283	591	1,518
60	120	255	532	1,367
70	110	233	487	1,251
80	102	216	451	1,159
90	95	202	422	1,083
100	89	190	397	1,019
125	79	167	349	897
150	71	150	314	807
200	60	127	266	684

1003.2 Piping size from regulator. To determine the size of piping between each consumer's MP regulator and the appliance or appliance regulator, proceed as follows:

- (a) Measure the length of piping from the consumers' MP regulator to the most remote outlet served by the regulator.
- (b) In the first vertical column in Table 1003B, select the horizontal line showing the distance or the next longer distance if the Table does not give the exact length.
- (c) Use this horizontal line to locate all gas demand figures for each section of gas piping served by the MP regulator.
- (d) Starting at the most remote outlet served by the MP regulator, find, in the horizontal line just selected, the gas demand for that outlet. If the exact figure of demand is not shown, choose the next larger figure to the right on the same line.
- (e) Above this demand figure in the top horizontal line in Table 1003B will be the size of tubing required.
- (f) For each succeeding section of tubing downstream of the MP regulator, determine the total gas demand supplied by each section and then proceed in accordance

TWO-PSI GAS PIPING

with the previously outlined provisions to determine the size of each section of tubing.

- (g) Follow the foregoing procedure to determine the size of tubing downstream of each MP regulator.

1003.3 Example. See Appendix B for example problem using Tables 1003A and 1003B.

**TABLE 1003B
SIZE OF GAS TUBING
MAXIMUM CAPACITY OF TUBING IN CUBIC FEET
OF GAS PER HOUR BASED ON A PRESSURE DROP
OF 1-INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY GAS**

LENGTH (feet)	OUTSIDE DIAMETER OF TUBING (inch)			
	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{7}{8}$
2	97	207	433	1,111
4	65	139	290	746
6	52	110	230	591
8	44	93	195	501
10	39	82	171	440
15	31	65	136	349
20	26	55	115	296
25	23	48	101	260
30	21	44	91	234
40	17	37	77	198
50	15	32	68	175
75	12	26	54	139
100	10	22	46	117

1003.4 Sizing requirements for special conditions.

1003.4.1 Maximum operating pressures. For conditions other than those set forth in Subsections 1003.1, 1003.2 and 1003.3, or those covered by Tables 1003A, 1003B and 1003C, such as longer runs or larger sizes of piping; greater gas demands; the application of a diversity factor when piping multiple-family dwellings; pressures other than 2 psi or lower than 4 inches of water column pressure; or specific gravity other than 0.55 to 0.75, the size of piping required shall be calculated in a manner satisfactory to the Chief Gas Inspector. (See Appendix C for 5-psi gas piping sizing information.) The maximum design operating pressure for piping systems located inside buildings shall be 5 psi, unless approved by the Chief Gas Inspector, and one or more of the following conditions are met:

- The piping system is welded.
- The piping is located in a ventilated chase or is otherwise enclosed for protection against accidental gas accumulation.
- The piping is located inside buildings or in separate areas of buildings that are used exclusively for:
 - Industrial processing or heating;
 - Research;
 - Warehousing; or

- Boiler or mechanical equipment rooms.

- (d) The piping is a temporary installation for buildings under construction.

1003.4.2 Larger piping sizes. Where piping sizes larger than those set forth in this Section are specified by piping sizing requirements established by the Chief Gas Inspector, these larger sizes shall be used.

1003.4.3 Alternative methods. In lieu of the method given in this Section for determining size of piping from the point of delivery to MP regulators, such piping sizes may be determined by using accurate gas flow computers or from pressure drop charts, both of which must be acceptable to the Chief Gas Inspector, so long as the resulting computed pressure drop does not exceed $1\frac{1}{2}$ psi and piping sizes are not larger than determined by this Section.

**TABLE 1003C
SIZE OF GAS PIPE
MAXIMUM CAPACITY OF PIPE IN CUBIC FEET OF GAS
PER HOUR BASED ON A PRESSURE DROP OF $1\frac{1}{2}$ PSI,
0.6 SPECIFIC GRAVITY GAS AND SCHEDULE 40 PIPE**

LENGTH (feet)	PIPE SIZE NOMINAL DIAMETER (inch)	
	$\frac{1}{2}$	$\frac{3}{4}$
10	1,990	4,170
20	1,370	2,860
30	1,100	2,300
40	940	1,970
50	830	1,740
60	760	1,580
70	700	1,450
80	650	1,350
90	610	1,270
100	570	1,200
125	510	1,060
150	460	960
175	425	890
200	395	820

SECTION 1004 EXISTING PIPING SYSTEMS

1004.1 Pressures in excess of 0.5 psi. Gas pressure in excess of $\frac{1}{2}$ psi shall not be supplied to existing systems of piping in residences or apartments when such piping is of adequate size for a $\frac{1}{2}$ -psi system, as determined by Section 305, to supply all appliances connected to the piping system.

SECTION 1005 GAS PIPING

1005.1 Materials. All piping shall be of metallic material and comply with Section 306.

Exception: Plastic piping or tubing and compatible fittings complying with ASTM D2513 shall be permitted to

be used underground outside the building. (See Subsection 309.14 for limitations.)

1005.2 Marking. All piping in the 2-psi portion of the system shall be marked at the beginning, all ends and at not less than 6-foot intervals along its length designating the 2-psi gas pressure.

1005.3 Tubing in partitions. This provision shall not apply to tubing that pierces walls, floors or partitions. Tubing shall be permitted to be installed vertically and horizontally inside hollow walls or partitions without protection along its entire concealed length, provided:

- (a) A steel striker barrier not less than 0.0508 inch thick, or equivalent, is installed between the tubing and the finished wall, and extends at least 4 inches beyond the concealed penetrations of the plates, firestops, wall studs, etc., and
- (b) The tubing is installed in single runs and is not rigidly secured.

SECTION 1006 MP REGULATORS

1006.1 General. MP pressure regulators installed in the 2-psi portions of the piping system shall comply with the following provisions:

- (a) The MP regulator shall comply with Subsections 402.1 and 402.13, and shall be stated by its manufacturer as being approved for the inlet and outlet gas pressures for which it is to be used.
- (b) The MP regulator shall maintain a reduced outlet pressure under lock-up (no flow) conditions.
- (c) The capacity of the MP regulator, determined by published ratings of its manufacturer, shall be adequate to supply the appliances served by it.
- (d) The MP pressure regulator shall be accessible for servicing and may be located either indoors or outdoors. When located indoors, the regulator shall be vented to the outdoors or equipped with a leak-limiting device, in either case complying with Subsection 402.13.
- (e) MP pressure regulators shall be so installed on the piping system that they cannot be concealed by building construction.

SECTION 1007 MANUAL SHUTOFF VALVE

1007.1 Shutoff valve requirement. Where there is more than one MP regulator in the complete piping system served by one meter, a listed shutoff valve shall be installed immediately ahead of each MP regulator.

SECTION 1008 TEST OF PIPING FOR TIGHTNESS

1008.1 General. All gas piping shall be tested in accordance with Section 311.

CHAPTER 11

REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard.

AGA

American Gas Association
400 North Capitol Street, NW
Suite 450
Washington, DC 20001
www.aga.org

Standard reference number	Title	Referenced in code section number
3—87	Requirements for Gas Connectors for Connection of Fixed Appliances for Outdoor Installation, Park Trailers and Manufactured (Mobile) Homes to the Gas Supply	315.6

ANSI

American National Standards Institute
25 West 43rd Street
4th Floor
New York, NY 10036
www.ansi.org

Standard reference number	Title	Referenced in code section number
LC-1/CSA 6.26—13	Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)	306.2
Z21.8—94(R2002)	Installation of Domestic Gas Conversion Burners	512
Z21.10.1/CSA 4.1—12	Gas Water Heaters—Volume I, Storage, Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.	504.6.1
Z21.10.3/CSA 4.3—11	Gas Water Heaters—Volume III, Storage, Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous	504.6.1
Z21.12—90(R2000)	Draft Hoods.	604.4
Z21.15/CSA 9.1—09	Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves	306.10
Z21.21—15	Automatic Valves for Gas Appliances	306.10
Z21.69/CSA 6.16—09	Connectors for Movable Gas Appliances	403.1.1
Z83.4/CSA 3.7—12	Non-Recirculating Direct-Gas-Fired Industrial Air Heaters.	514.1.1
Z83.18—12	Recirculating Direct-Gas-Fired Industrial Air Heaters.	515.1.1

API

American Petroleum Institute
1200 L Street, NW
Washington, DC 20005
www.api.org

Standard reference number	Title	Referenced in code section number
1104—14	Welding of Pipelines and Related Facilities—20th Edition, Includes Errata 1 (2007) and 2 (2008)	306.5.3

ASHRAE

ASHRAE
1791 Tullie Circle, NE
Atlanta, GA 30329
www.ashrae.org

Standard reference number	Title	Referenced in code section number
ASHRAE Handbook—12	HVAC Systems and Equipment	507.6

REFERENCED STANDARDS

ASME

American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016
www.asme.org

Standard reference number	Title	Referenced in code section number
B1.20.1—83(R2006)	Pipe Threads, General Purpose (Inch)	307.1
B16.1—10	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250	309.15.1
B16.20—17	Metallic Gaskets for Pipe Flanges	309.15.1
B16.33—12	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psig (Sizes 1/2 through 2)	306.10
B31.1—12	Power Piping	306.5.3
B36.10M—04	Welded and Seamless Wrought-Steel Pipe	306.1, 902.1.1
BPVC—10/11 addenda	ASME Boiler and Pressure Vessel Code (2007) Edition	306.5.3

ASTM

ASTM International
100 Bar Harbor Drive
West Conshohocken, PA 19428
www.astm.org

Standard reference number	Title	Referenced in code section number
A53/A 53M—12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless	306.1
A106/A106M—11	Seamless Carbon Steel Pipe for High-Temperature Service	306.1
A254—97(07)	Copper-Brazed Steel Tubing	306.2
A539—99(Withdrawn 2004)	Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines	306.2, 902.1.1
B88—09	Seamless Copper Water Tube	306.2, 902.1.1
B280—08	Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service	902.1.1
D2385—87(Withdrawn 1995)	Test for Hydrogen Sulfide and Mercaptan Sulfur in Natural Gas (Cadmium-Sulfate Iodometric Titration Method)	306.1, 306.2
D2420—13	Test for Hydrogen Sulfide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)	306.1, 306.2
D2513—13el	Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings	306.3, 902.1.1, 1005.1
D2517—06(2011)	Reinforced Epoxy Resin Gas Pressure Pipe and Fittings	306.3
D2683—14	Socket-Type Polyethylene for Outside Diameter-Controlled Polyethylene (PG) Pipe	902.1.1
D3261—12el	Butt Heat-Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Pipe and Tubing	902.1.1

CODES

This model code is intended to be utilized in conjunction with the other model codes that are adopted by the jurisdiction.

Standard reference number	Title	Referenced in code section number
	EPCOT Building Code—2018 Edition	105, 111.1, 201.3, 309.1, 407, 709
	EPCOT Energy Efficiency Code for Building Construction—2018 Edition	525.1
	EPCOT Fire Prevention Code—2018 Edition	201.3
	EPCOT Mechanical Code—2018 Edition	107, 201.3, 507.9, 507.12
	EPCOT Plumbing Code—2018 Edition	201.3, 504.2.2, 507.14.3

GAMA

Gas Appliance Manufacturers Association
[Formerly The Hydronics Institute (HYDI)]
2107 Wilson Boulevard
Suite 600
Arlington, VA 22201
www.gamanet.org

Standard reference number	Title	Referenced in code section number
IBR 200-89	Installation Guide for Residential Hydronic Heating Systems	507.6
IBR 250-95	Advanced Installation Guide for Hydronic Heating Systems	507.6

HUD

US Department of Housing and Urban Development
451 7th Street, SW
Washington, DC 20410

Standard reference number	Title	Referenced in code section number
24 CFR, Part 3280—08	Manufactured Home Construction and Safety Standards	406

MSS

Manufacturers Standardization Society of the
Valve and Fittings Industry
127 Park Street, Northeast
Vienna, VA 22180
www.mss-hq.com

Standard reference number	Title	Referenced in code section number
SP 6—12	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings	309.15.1

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269
www.nfpa.org

37—15	Stationary Combustion Engines and Gas Turbines	524
52—19	Vehicular Natural Gas Fuel Systems	529
54—18	National Fuel Gas Code611.1
70—14	National Electrical Code309.12.1, 404.1

APPENDIX A

FLOW OF GAS THROUGH FIXED ORIFICES

TABLE A-1
NATURAL GAS
CUBIC FEET PER HOUR AT SEA LEVEL

ORIFICE SIZE	PRESSURE AT ORIFICE (inches of water column)							
	3	4	5	6	7	8	9	10
80	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9
79	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0
78	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.2
77	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
76	1.1	1.1	1.4	1.5	1.6	1.7	1.8	1.9
75	1.2	1.3	1.5	1.6	1.8	1.9	2.0	2.1
74	1.3	1.6	1.7	1.9	2.1	2.2	2.3	2.4
73	1.5	1.8	2.0	2.2	2.3	2.5	2.6	2.8
72	1.6	1.9	2.2	2.4	2.5	2.7	2.9	3.0
71	1.8	2.1	2.3	2.5	2.7	2.9	3.1	3.3
70	2.1	2.4	2.7	3.0	3.2	3.4	3.6	3.8
69	2.3	2.6	3.0	3.2	3.5	3.7	3.9	4.1
68	2.5	2.9	3.3	3.6	3.9	4.1	4.4	4.6
67	2.7	3.1	3.5	3.9	4.1	4.4	4.7	4.9
66	2.9	3.3	3.8	4.1	4.4	4.7	5.0	5.2
65	3.1	3.7	4.3	4.6	4.8	5.2	5.5	5.8
64	3.4	4.1	4.5	4.9	5.2	5.6	6.0	6.3
63	3.6	4.2	4.8	5.2	5.6	5.9	6.3	6.6
62	3.8	4.4	5.0	5.4	5.8	6.2	6.6	6.9
61	4.0	4.7	5.3	5.8	6.2	6.6	7.0	7.4
60	4.2	4.9	5.5	6.0	6.5	6.9	7.4	7.7
59	4.4	5.1	5.8	6.4	6.8	7.3	7.7	8.1
58	4.7	5.4	6.1	6.7	7.1	7.6	8.1	8.5
57	4.8	5.6	6.4	7.0	7.4	7.9	8.5	8.9
56	5.7	6.6	7.4	8.0	8.7	9.3	9.9	10.4
55	7.1	8.2	9.3	10.2	10.9	11.6	12.3	13.0
54	8.0	9.2	10.5	11.4	12.3	13.1	13.9	14.7
53	9.3	10.8	12.2	13.3	14.3	15.3	16.3	17.1
52	10.6	12.3	13.9	15.3	16.3	17.4	18.6	19.5
51	11.8	13.7	15.5	17.0	18.2	19.4	20.6	21.7
50	12.9	14.9	16.9	18.5	19.8	21.1	22.5	23.7
49	14.1	16.3	18.4	20.2	21.6	23.1	24.6	25.8
48	15.2	17.6	19.9	21.8	23.3	24.9	26.5	27.9
47	16.2	18.8	21.3	23.2	24.9	26.6	28.3	29.8
46	17.2	20.0	22.6	24.7	26.4	28.2	30.1	31.6
45	17.7	20.5	23.1	25.4	27.2	29.0	30.9	32.5
44	19.5	22.6	25.6	27.9	29.9	31.9	34.0	35.7
43	20.7	24.2	27.3	29.9	32.0	34.2	36.4	38.3
42	23.1	26.5	29.5	32.5	35.2	37.6	40.1	42.1
41	24.1	28.2	31.7	34.8	37.2	39.7	42.3	44.5
40	25.0	29.2	33.1	36.2	38.8	41.4	44.1	46.4
39	26.1	30.2	34.1	37.4	40.0	42.7	45.4	47.8
38	27.1	31.4	35.5	38.9	41.6	44.4	47.3	49.7
37	28.4	33.0	37.1	40.8	43.6	46.6	49.6	52.2
36	29.8	34.6	39.1	42.8	45.8	48.9	52.0	54.7

TABLE A-1—Continued
NATURAL GAS
CUBIC FEET PER HOUR AT SEA LEVEL

ORIFICE SIZE	PRESSURE AT ORIFICE (inches of water column)							
	3	4	5	6	7	8	9	10
35	32.4	36.9	41.7	45.7	48.8	52.1	55.5	58.3
34	32.5	37.5	42.4	46.5	49.8	53.1	56.6	59.5
33	33.4	38.8	43.8	48.0	51.5	55.0	58.6	61.6
32	35.5	40.9	46.5	50.8	54.3	58.0	61.7	64.9
31	37.8	43.8	49.6	54.4	58.0	62.0	66.0	69.4
30	43.4	50.4	57.1	62.1	66.7	71.2	75.9	79.8
29	48.5	56.2	63.6	69.6	74.5	79.5	84.7	89.0
28	51.8	59.5	67.0	73.5	79.5	84.9	90.4	95.1
27	54.5	63.2	71.6	78.3	83.6	89.3	95.0	100.0
26	56.7	65.9	74.6	81.7	87.2	93.2	99.2	105.0
25	58.9	68.2	77.1	84.7	90.4	96.5	103.0	108.0
24	60.8	70.6	79.8	87.6	93.5	99.8	106.0	112.0
23	62.1	72.2	81.7	89.4	94.6	101.0	107.0	113.0
22	64.9	75.2	85.1	93.3	99.6	106.0	113.0	119.0
21	66.5	77.1	87.4	95.6	102.0	109.0	116.0	122.0
20	68.2	79.1	89.5	98.0	105.0	112.0	119.0	125.0
19	72.2	83.7	94.8	104.0	111.0	119.0	126.0	132.0
18	75.5	87.6	97.5	109.0	116.0	124.0	132.0	139.0
17	78.5	91.1	103	113.0	120.0	129.0	137.0	144.0
16	82.2	95.4	108	118.0	127.0	135.0	144.0	152.0
15	85.2	98.8	112	122.0	131.0	140.0	149.0	157.0
14	86.0	101.0	114	124.0	133.0	142.0	151.0	159.0
13	89.9	104.0	118	129.0	139.0	148.0	158.0	166.0
12	93.9	109.0	124	135.0	144.0	154.0	164.0	172.0
11	95.9	111.0	126	138.0	147.0	157.0	167.0	176.0
10	98.3	114.0	129	142.0	152.0	162.0	172.0	181.0
9	101.0	117.0	133	145.0	155.0	165.0	176.0	185.0
8	104.0	121.0	136	149.0	160.0	171.0	182.0	191.0
7	106.0	123.0	139	153.0	163.0	174.0	186.0	195.0
6	109.0	127.0	143	157.0	168.0	179.0	190.0	200.0
5	111.0	129.0	146	160.0	171.0	182.0	194.0	204.0
4	115.0	133.0	150	164.0	176.0	188.0	200.0	211.0
3	119.0	138.0	156	171.0	183.0	195.0	208.0	218.0
2	128.0	149.0	169	185.0	198.0	211.0	225.0	236.0
1	136.0	158.0	179	195.0	209.0	224.0	238.0	251.0

Notes:

(a) Specific gravity = 0.60.

(b) Orifice coefficient = 0.090.

(c) For utility gases of another specific gravity, select a multiplier from Table A3.

APPENDIX A—FLOW OF GAS THROUGH FIXED ORIFICES

TABLE A-2
FLOW OF GAS THROUGH FIXED ORIFICES
LP GASES (PROPANE)
BTU PER HOUR AT SEA LEVEL

DRILL SIZE	PROPANE	DRILL SIZE	PROPANE
0.008	500	51.0	35,330
0.009	641	50.0	38,500
0.010	791	49.0	41,850
0.011	951	48.0	45,450
0.012	1,130	47.0	48,400
80.0	1,430	46.0	51,500
79.0	1,655	45.0	52,900
78.0	2,015	44.0	58,050
77.0	2,545	43.0	62,200
76.0	3,140	42.0	68,700
75.0	3,465	41.0	72,450
74.0	3,985	40.0	75,400
73.0	4,525	39.0	77,850
72.0	4,920	38.0	81,000
71.0	5,320	37.0	85,000
70.0	6,180	36.0	89,200
69.0	6,710	35.0	95,000
68.0	7,560	34.0	97,000
67.0	8,040	33.0	101,000
66.0	8,550	32.0	105,800
65.0	9,630	31.0	113,200
64.0	10,200	30.0	129,700
63.0	10,800	29.0	145,700
62.0	11,360	28.0	154,700
61.0	11,930	27.0	163,100
60.0	12,570	26.0	169,900
59.0	13,200	25.0	175,500
58.0	13,840	24.0	181,700
57.0	14,550	23.0	186,800
56.0	16,990	22.0	193,500
55.0	21,200	21.0	198,600
54.0	23,850	20.0	203,700
53.0	27,790	19.0	217,100
52.0	31,730	18.0	225,600

Notes:

- Btu per cubic foot = 2,500.
- Specific gravity = 1.53.
- Pressure at orifice, inches of water column = 11.
- Orifice coefficient = 0.90.

TABLE A-3
MULTIPLIER FOR NATURAL GAS OF ANOTHER
SPECIFIC GRAVITY

SPECIFIC GRAVITY	MULTIPLIER
0.45	1.155
0.50	1.095
0.55	1.045
0.60	1.000
0.65	0.961
0.70	0.926
0.75	0.894

APPENDIX B

EXAMPLE PROBLEMS

SECTION B-101 EXAMPLE USING TABLES 305.3.3 AND 305.4A

B-101.1 Problem. Determine the required pipe size of each section and outlet of the piping system shown in Figure B-101. Gas to be used has a 0.60 specific gravity and 1,000 Btu per cubic foot, delivered at 6 inches of water column pressure.

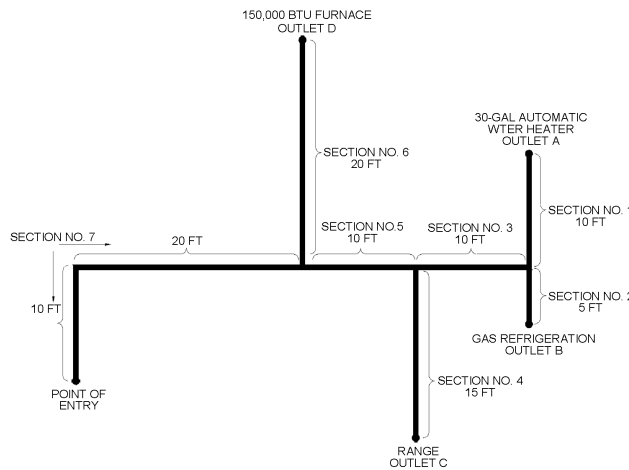


FIGURE B-101
SIZING A 1/2-POUND OR LESS SYSTEM

B-101.2 Solution.

- (a) Maximum gas demand of:
 1. Outlet A is 30 cubic feet per hour. (See Table 305.3.3).
 2. Outlet B is 3 cubic feet per hour. (See Table 305.3.3).
 3. Outlet C is 65 cubic feet per hour (See Table 305.3.3).
 4. Outlet D is 150 cubic feet per hour (150,000 Btu per hour/1,000).
- (b) The length of piping from the point of delivery to the most remote outlet (Outlet A) is 60 feet. This is the only distance used.
- (c) Using the line marked 60 feet in Table 305.4A:
 1. Outlet A, supplying 30 cubic feet per hour, requires a 1/2-inch pipe.
 2. Outlet B, supplying 3 cubic feet per hour, requires a 1/2-inch pipe.
 3. Outlet C, supplying 65 cubic feet per hour, requires a 1/2-inch pipe.

4. Outlet D, supplying 150 cubic feet per hour, requires a 1-inch pipe.
- (d) Section Supply Outlet:
1. Section 1, supplying Outlet A or 30 cubic feet per hour requires a 1/2-inch pipe.
 2. Section 2, supplying Outlet B or 3 cubic feet per hour requires a 1/2-inch pipe.
 3. Section 3, supplying Outlets A and B, or 33 cubic feet per hour requires a 1/2-inch pipe.
 4. Section 4, supplying Outlet C or 65 cubic feet per hour requires a 1/2-inch pipe.
 5. Section 5, supplying Outlets A, B and C, or 98 cubic feet per hour requires a 3/4-inch pipe.
 6. Section 6, supplying Outlet D or 150 cubic feet per hour requires a 1-inch pipe.
 7. Section 7, supplying Outlets A, B, C and D, or 248 cubic feet per hour requires a 1-inch pipe.

SECTION B-102 EXAMPLE USING TABLES 1003A AND 1003B

B102.1 Problem. Determine the required tubing size for each section of piping shown in Figure B102. Gas to be used has a 0.60 specific gravity and 1,000 Btu per cubic foot, supplied at a 2-pound-per-square-inch (psi) pressure at the point where consumers' gas piping begins and is reduced to an appliance utilization pressure by the MP regulators.

B-102.2 Solution.

B-102.2.1 2-psi piping.

- (a) The length of tubing from the start of the consumers' gas piping to the most remote MP regulator is 60 feet. This is the only distance used for 2-psi piping.
- (b) Using the line marked 60 feet in Table 1003A:
 1. Section 4, supplying 33 cubic feet per hour, requires 3/8-inch outside diameter tubing.
 2. Section 5, supplying 65 cubic feet per hour, requires 3/8-inch outside diameter tubing.
 3. Section 7, supplying 98 cubic feet per hour, requires 3/8-inch outside diameter tubing.
 4. Section 8, supplying 150 cubic feet per hour, requires 1/2-inch outside diameter tubing.
 5. Section 10, supplying 248 cubic feet per hour, requires 1/2-inch outside diameter tubing.

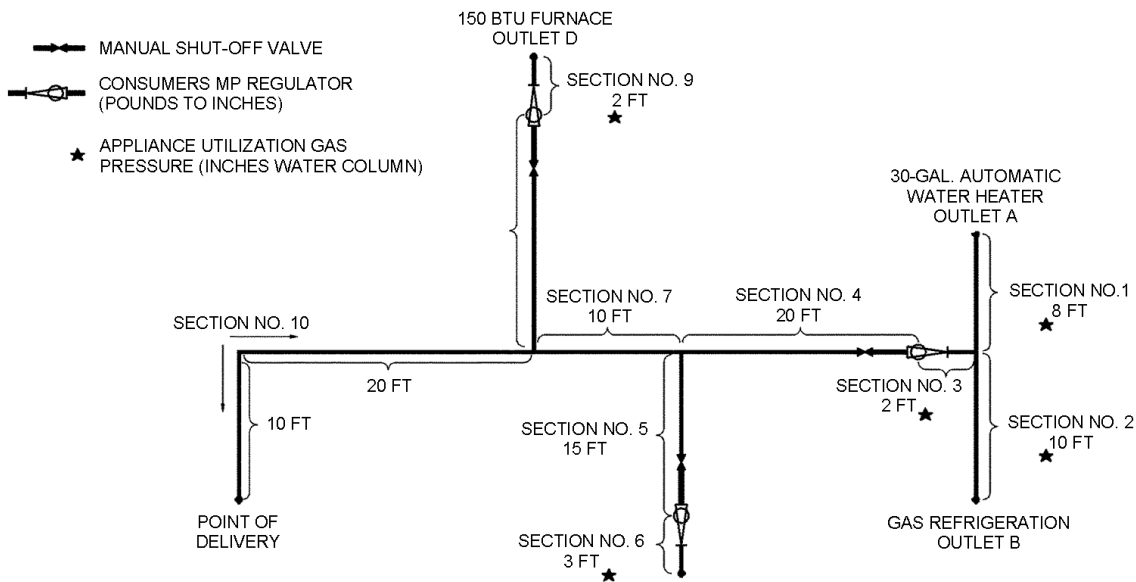


FIGURE B-102
SIZING 2-PSI SYSTEM

B-102.2.2 Tubing from the MP regulator to the appliance or appliance regulator.

- (a) The length of tubing from the MP regulator to the most remote outlet served by it is the only distance used in Table 1003B for sizing tubing downstream of the MP regulator.
- (b) Piping sizes determined by using Table 1003B:
 1. Section 1, supplying 30 cubic feet per hour, requires $\frac{3}{8}$ -inch outside diameter tubing. (See Column 1 for 15 feet.)
 2. Section 2, supplying 3 cubic feet per hour, requires $\frac{3}{8}$ -inch outside diameter tubing. (See Column 1 for 15 feet.)
 3. Section 3, supplying 33 cubic feet per hour, requires $\frac{1}{2}$ -inch outside diameter tubing. (See Column 1 for 15 feet.)
 4. Section 6, supplying 65 cubic feet per hour, requires $\frac{3}{8}$ -inch outside diameter tubing. (See Column 1 for 4 feet.)
 5. Section 9, supplying 150 cubic feet per hour, requires $\frac{1}{2}$ -inch outside diameter tubing. (See Column 1 for 2 feet.)

APPENDIX C

FIVE-PSI GAS SIZING

TABLE C-1
PIPING SIZING TABLE FOR A 5-POUND PRESSURE CAPACITY OF PIPES OF DIFFERENT DIAMETERS AND LENGTHS IN CUBIC FEET PER HOUR FOR AN INITIAL PRESSURE OF 5.0 PSIG WITH A 10-PERCENT PRESSURE DROP AND A SPECIFIC GRAVITY GAS OF 0.6

PIPE SIZE OF SCHEDULE 40 STANDARD PIPE (inches)	INTERNAL DIAMETER	TOTAL EQUIVALENT LENGTH OF PIPE (feet)										
		50	100	150	200	250	300	400	500	1,000	1,500	2,000
1.00	1.049	1,989	1,367	1,098	940	833	755	646	572	393	316	270
1.25	1.380	4,084	2,807	2,254	1,929	1,710	1,549	1,326	1,175	808	649	555
1.50	1.610	6,120	4,206	3,378	2,891	2,562	2,321	1,987	1,761	1,210	972	832
2.00	2.067	11,786	8,101	6,505	5,567	4,934	4,471	3,827	3,391	2,331	1,872	1,602
2.50	2.469	18,785	12,911	10,368	8,874	7,865	7,126	6,099	5,405	3,715	2,983	2,553
3.00	3.068	33,209	22,824	18,329	15,687	13,903	12,597	10,782	9,556	6,568	5,274	4,514
3.50	3.548	48,623	33,418	26,836	22,968	20,356	18,444	15,786	13,991	9,616	7,722	6,609
4.00	4.026	67,736	46,555	37,385	31,997	28,358	25,694	21,991	19,490	13,396	10,757	9,207
5.00	5.047	122,544	84,224	67,635	57,887	51,304	46,485	39,785	35,261	24,235	19,461	16,656
6.00	6.065	198,427	136,378	109,516	93,732	83,073	75,270	64,421	57,095	39,241	31,512	26,970
8.00	7.981	407,692	280,204	225,014	192,583	170,683	154,651	132,361	117,309	80,626	64,745	55,414
10.00	10.020	740,477	508,926	408,686	349,782	310,005	280,887	240,403	213,065	146,438	117,595	100,646
12.00	11.938	1,172,269	805,694	647,001	553,749	490,777	444,680	380,588	337,309	231,830	186,168	159,336

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EPCOT

MECHANICAL CODE

2018 EDITION

**AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT**

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LAKE BUENA VISTA, FL
32830**

INTERNATIONAL CODE COUNCIL®

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MECHANICAL CODE

2018 EDITION

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FOREWORD

The purpose of the *EPCOT Mechanical Code*® is to serve as a comprehensive regulatory document to guide decisions aimed at protecting the public's life, health, safety and welfare in the built environment. This protection is provided through the adoption and enforcement, by state and local governments, of the performance-based provisions contained herein.

The use of performance-based requirements encourages the use of innovative building designs, materials and construction systems, while at the same time recognizing the merits of the more traditional materials and systems. This concept promotes maximum flexibility in building design and construction, as well as assuring a high degree of life safety.

The *EPCOT Mechanical Code* incorporates, by reference, nationally recognized consensus standards for use in judging the performance of materials and systems. This provides for the equal treatment of both innovative and traditional materials and systems, provides for the efficient introduction of new materials into the construction process and assures a high level of consumer protection.

PREFACE

Introduction

Internationally, Code Officials recognize the need for a modern, up-to-date mechanical code addressing the design and installation of mechanical systems through requirements emphasizing performance. The *EPCOT Mechanical Code* is designed to meet these needs through model code regulations that safeguard the public's health and safety in all communities, large and small.

This comprehensive mechanical code establishes minimum regulations for mechanical systems using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new mechanical designs.

Marginal Markings

Solid vertical lines in the margins within the body of this Code indicate a change from the requirements of the 2015 edition, except where a change was minor. Deletion indicators (➡) are provided in the margin where an entire section, paragraph, exception or table has been deleted if the deletion resulted in a change of requirements.

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CHAPTER 1

ADMINISTRATION

SECTION 101 TITLE AND SCOPE

101.1 Title. The provisions in the following Chapters and Sections of this volume, together with the Appendices, shall constitute and be known as “The *EPCOT Mechanical Code*,” hereafter referred to as “this Code.”

101.2 Code remedial. This Code is hereby declared to be remedial, and shall be constructed to secure the beneficial interest and purposes thereof, which are health, sanitation, general public safety and welfare, by regulating the installation and maintenance of all mechanical equipment.

101.3 Scope. The provisions of this Code shall apply to the installation of mechanical systems, including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and/or appurtenances thereto, including ventilating, heating, cooling, air-conditioning and refrigeration systems, incinerators and other energy-related systems.

101.4 Maintenance. All mechanical systems, both existing and new, and all parts thereof, shall be maintained in a safe condition. All devices or safeguards that are required by this Code shall be maintained in good working order. The maintenance of mechanical systems shall be the responsibility of the owner or his designated agent.

101.5 Abandonment of equipment, duct work, vents, piping and/or fittings.

101.5.1 Abandonment of equipment. All abandoned equipment shall be removed.

101.5.2 Abandonment of ductwork. All abandoned ductwork shall be removed.

101.5.3 Abandonment of vents. Abandoned inlet openings in chimneys and vents shall be closed by an approved method, sealed and permanently labeled as abandoned.

101.5.4 Abandonment of piping and/or fittings. Abandoned piping and/or fittings shall be removed.

Exception: If it is technically infeasible to remove the pipe and/or fittings, the pipe and/or fittings may be abandoned in place, at the discretion of the Chief Mechanical Inspector. To abandon in place requires the pipe and/or fittings to be filled and sealed with grout equal to Class “C” concrete. The grout shall form a solid waterproof plug completely bonded to the pipe, and the pipe shall be permanently labeled as abandoned.

101.6 Abandonment of smoke/fire damper. Abandoned smoke/fire dampers require the damper to be removed and the wall/ceiling assembly shall be filled in to meet the fire-resistive rating of the existing wall/ceiling.

Exception: If it is technically infeasible to remove the fire/smoke damper, the damper may be allowed to be abandoned in place, at the discretion of the Chief Mechan-

ical Inspector. To abandon in place requires the damper to be closed and secured in the closed position and permanently labeled as abandoned.

SECTION 102 ORGANIZATION

102.1 Creation of a mechanical division. There is hereby created in the Department and of Building and Safety of the Reedy Creek Improvement District (the District) the Mechanical Division, which shall be responsible to the Building Official.

102.2 Appointment of chief mechanical inspector. The Building Official, with the concurrence of the District Administration, shall appoint a Chief Mechanical Inspector. Such person shall have not less than 10 years experience in charge of the installation and/or inspection of heating, ventilating, refrigerating and air-conditioning systems. He shall serve under the direction of the Building Official.

102.3 Restrictions on employees. No officer or employee connected with the Department of Building and Safety shall be financially interested in the furnishing of labor, material or appliances for the construction, alteration or maintenance of mechanical installations, or in the making of plans or specifications therefor, unless he is the owner of such building. No such officer or his employee shall engage in any work that is inconsistent with his duties or with the interests of the Department.

SECTION 103 POWERS AND DUTIES OF THE CHIEF MECHANICAL INSPECTOR

103.1 Right of entry. Whenever necessary to make an inspection to enforce the requirements of this Code, and whenever the Chief Mechanical Inspector has reason to believe that there exists on any premises an installation of mechanical equipment that creates an unsafe condition, the Chief Mechanical Inspector shall enter a building or premises at reasonable times to inspect the installation or to perform a duty imposed by this Code. If the building or premises is occupied, the Chief Mechanical Inspector shall first present his credentials and request entry. If entry is refused, the Chief Mechanical Inspector shall report that fact to the Building Official who shall determine what action is to be taken under the requirements of Subsection 104.5 of the *EPCOT Building Code*.

103.2 Stop work orders. Upon notice from the Chief Mechanical Inspector that work on any mechanical installation is being done contrary to the provisions of this Code, or in a dangerous or unsafe manner, such work shall be immediately stopped. Such notice shall be in writing and shall be given to the owner of such property, or to his agent, or the person doing the work, and shall state the conditions under which work may be resumed. Where any emergency exists,

oral notice given by the Chief Mechanical Inspector shall be sufficient.

103.3 Revocation of permits. The Chief Mechanical Inspector may revoke a permit or approval issued under the provisions of this Code in case there has been any false statement or misrepresentations as to the material fact in the application or plans on which the permit or approval was based. In all such cases, permit fees shall not be refunded.

103.4 Unsafe installations. Whenever the Chief Mechanical Inspector learns that equipment, whose installations is regulated by this Code, has become hazardous to life, health or property, he shall order, in writing, that the equipment be removed or brought up to code requirements. The written notice shall set a time limit for compliance with the order. No person shall use or maintain defective equipment after written notice has been received from the Chief Mechanical Inspector. Failure to comply with the notice shall cause the equipment to be abated in accordance with the procedure established in Section 104 of the *EPCOT Building Code*.

103.5 Requirements not covered by code. Any requirement necessary for the safety, strength or stability of an existing or proposed mechanical installation, or for the safety of the occupants of a building or structure, not specifically covered by this Code, shall be determined by the Chief Mechanical Inspector.

103.6 Alternative materials and methods of installations. Alternative materials and methods of installations shall be approved in accordance with this Subsection.

- (a) In existing buildings or premises in which mechanical installations are to be altered, repaired or renovated, the Chief Mechanical Inspector has discretionary power to permit deviation from the provisions of this Code, provided that such proposal to deviate is first submitted for proper determination in order that health and safety requirements, as they pertain to mechanical installations, shall be observed.
- (b) Provisions of this Code are not intended to prevent the use of any material, device, method of assemblage, or installation, fixture or appurtenances not specifically authorized, provided such alternative has been approved by the Chief Mechanical Inspector.
- (c) The Chief Mechanical Inspector shall require sufficient evidence to enable him to judge whether proposed alternatives meet the requirements of this Code for health and safety.
- (d) Where there is not sufficient evidence to substantiate claims for alternatives, the Chief Mechanical Inspector shall require tests of compliance as proof to be made by an approved agency at the expense of the applicant. Tests shall be made in accordance with generally recognized standards; but in the absence of such standards, the Chief Mechanical Inspector shall specify the test procedure.

Tests shall be required to be repeated if, at any time, there is reason to believe that an alternative no longer conforms to the requirements on which its approval was based.

103.7 Liability. Any officer or employee, or member of any board, charged with the enforcement of this Code, acting for the District in the discharge of his duties, shall not thereby render himself liable personally, and he is hereby relieved from all personal liability for any damage that may occur to persons or property as a result of any act required or permitted in the discharge of his duties. Any suit brought against any officer or employee because of such act performed by him in the enforcement of any provision of this Code shall be defended by the Legal Council of the District until the final termination of the proceedings.

SECTION 104 APPLICATION FOR PERMIT

104.1 When required. A permit shall be obtained from the Chief Mechanical Inspector to install, alter or reconstruct heating and ventilating, air-conditioning and refrigerating equipment, and for such equipment moved into or installed in a relocated building. A separate permit shall be obtained for the equipment in each separate building.

104.2 Permits not required. Permits shall not be required for the following:

- (a) Electrical portable heating appliance;
- (b) Portable ventilation equipment;
- (c) Portable cooling unit;
- (d) Steam, hot or chilled water piping within any heating or cooling equipment regulated by this Code;
- (e) Replacement of any part that does not alter its approval or make it unsafe; or
- (f) Portable, evaporative, cool and self-contained refrigeration systems containing 10 pounds or less of refrigerant, and actuated by motors of 1 horsepower or less.

104.3 Form. The applicant shall file an application on forms supplied by the Department of Building and Safety. The application for permit shall provide all the information needed for the enforcement of this Code.

104.4 Drawings and specifications. Whenever, in the opinion of the Chief Mechanical Inspector, drawings and specifications are needed to show definitively the nature and character of the work for which the application is made, the applicant shall furnish such drawings and specifications. These drawings and specifications shall be drawn to scale and submitted in duplicate. If approved, one set shall be returned to the applicant, marked approved, and one set shall be retained and filed as a permanent record in the office of the Chief Mechanical Inspector. The applicant's approved set shall remain, at all times, on the job site. Such information or drawings and specifications shall be specific, and this Code shall not be cited in whole or in part, nor shall the term "legal" or its equivalent be issued as a substitute for specific information. The Chief Mechanical Inspector shall require the drawings and specifications to be certified by a registered engineer.

104.5 Examination of drawings. The Chief Mechanical Inspector shall examine or cause to be examined each application for a permit, and the drawings and specifications that may be filed therewith, and shall ascertain by such examina-

tion whether the installation indicated and described is in accordance with the requirements of this Code and all other pertinent laws or ordinances.

SECTION 105 PERMITS

105.1 Action on application.

- (a) If the Chief Mechanical Inspector is satisfied that the work described in an application for a permit, and the drawings and specifications that shall be filed therewith, conform to the requirements of this Code, and other pertinent laws and ordinances, he shall issue a permit therefore to the applicant that shall be posted on the job site.
- (b) If the application for permit, and the drawings and specifications that shall be filed therewith, describe work that does not conform to the requirements of this Code, or other pertinent laws or ordinances, the Chief Mechanical Inspector shall not issue a permit but shall return the drawings to the applicant with his refusal to issue such a permit. Such refusal shall, when requested, be in writing and shall contain the reasons therefore.
- (c) Issuance of a permit based on plans and specifications shall not prevent the Chief Mechanical Inspector from thereafter requiring the correction of errors in the plans and specifications, or from preventing construction from being carried on thereunder when the construction is in violation of this Code, the *EPCOT Building Code* or the land use regulations of the District.

105.2 Condition of permit. The Chief Mechanical Inspector shall act upon the application for a permit with plans as filed or amended, without unreasonable or unnecessary delay. A permit issued shall be construed to be authorization to proceed with the work, and shall not be construed as authority to violate, cancel, alter or set aside any of the provisions of this Code, nor shall such issuance of a permit prevent the Chief Mechanical Inspector from thereafter requiring the correction of errors in plans or construction, or of violations of this Code. Any permit issued shall become invalid unless the work authorized by it shall have been commenced within six months after its issuance, or if the work authorized by such permit is suspended or abandoned for a period of six months after the time the work is commenced; provided, that for cause, one or more extensions of time for periods not exceeding 90 days each, shall be allowed, in writing, by the Chief Mechanical Inspector.

- (a) The Chief Mechanical Inspector shall, in writing, suspend or revoke a permit issued under the provisions of this Code when the permit has been issued in error or was based on incorrect information supplied by the applicant, or when the work being done is in violation of the requirements of this Code, the *EPCOT Building Code* or land use regulations of the District.

SECTION 106 FEES

106.1 Permit fees. Upon payment of the total permit fee as determined by using the Schedule of Building Permit Fees, as adopted by the Board of Supervisor's of the District, the Chief Mechanical Inspector shall issue a mechanical permit. Permit fees shall be based on the contract or selling price of the installation or alteration, and shall include electrical, plumbing, mechanical, sprinkler, elevator and owner-furnished equipment.

SECTION 107 INSPECTIONS

107.1 Inspection required. All new work and such portions of existing systems as may be affected by new work, or any changes, shall be inspected to ensure compliance with all the requirements of this Code, and to ensure that the installation and construction of the mechanical system is in accordance with the approved plans.

107.2 Notification.

- (a) **Advance notice.** It shall be the duty of the installer to give reasonable advance notice to the Chief Mechanical Inspector when work is ready for test or inspection.
- (b) **Installer's responsibility.** It shall be the duty of the installer to make sure that the work will stand the test prescribed before giving the advanced notice.
- (c) **Retesting.** If the Chief Mechanical Inspector finds that the work will not pass the test, the installer shall be required to make the necessary corrections and the work shall then be resubmitted for inspection. Where additional inspections are necessary for retesting, there shall be an additional fee for each such inspection in accordance with the fee schedule.

107.3 Material and labor inspections. The equipment, material, power and labor necessary for the inspection and test shall be furnished by the installer.

107.4 Inspections. All equipment for which a permit is obtained under this Code shall be inspected and, when in compliance with this Code, approved by the Chief Mechanical Inspector. Any portion of any equipment intended to be concealed by any permanent portion of the building shall not be concealed until inspected and approved by the Chief Mechanical Inspector. When the installation of any equipment is complete, a final inspection shall be made. Equipment regulated by this Code shall not be connected to the fuel or power supply and placed in normal operation until it complies with all the applicable requirements of this Code and a final inspection approval has been issued.

A final inspection approval shall, upon notice, be revoked by the Chief Mechanical Inspector if it is found that the mechanical system fails in any respect to comply with the requirements of this Code, so that the installation is unsafe, dangerous or hazardous to life. The Chief Mechanical Inspector shall accept inspection certification reports from an approved agency, in lieu of on-site inspection, when on-site inspection is impractical.

SECTION 108 CERTIFICATE OF CONSTRUCTION COMPLETION

108.1 Rough-in inspection. Upon the satisfactory completion of the roughing-in inspection, approval shall be so noted on the permit card. This approval shall give the date of the roughing-in inspection and the initials of the Chief Mechanical Inspector.

108.2 Final inspection.

- (a) When the installation of equipment is complete, a second and final inspection shall be made.
- (b) Equipment regulated by this Code shall not be connected to a fuel or power supply until a final inspection has been made and an approval has been issued.

108.3 Temporary approval. A temporary Certificate of Construction Completion shall be issued for a portion or portions of a mechanical system that shall be safely operated prior to the final completion of the building.

SECTION 109 VIOLATIONS AND PENALTIES

109.1 Violation penalties. A person, firm, corporation or agent who shall violate any requirement of this Code, or who shall fail to comply therewith, or who shall install, alter, repair or maintain equipment regulated by this Code in violation of a detailed statement or drawing submitted and approved by the Chief Mechanical Inspector, shall be guilty of a misdemeanor and shall be subject to the penalty provided in Section 67, Chapter 67-764, Laws of Florida, Special Acts of 1967.

SECTION 110 APPEALS

110.1 Board of appeals. The Board of Appeals established by Section 106 of the *EPCOT Building Code* shall serve as the Board of Appeals when requests for the use of alternative materials, systems or methods of design or installation of heating, ventilating, air-conditioning and refrigerating equipment have been rejected by the Chief Mechanical Inspector or the Building Official. The same Board of Appeals shall provide reasonable interpretations of this Code when an appeal of the decision from the Chief Mechanical Inspector or the Building Official has been filed.

SECTION 111 QUALIFICATION OF CONTRACTORS

111.1 Qualification requirements. Whoever desires to engage in the business of installing heating and ventilating, air-conditioning or refrigerating systems, incinerators or other heat-producing apparatus, or who offers such services in the District shall satisfy the Building Official as to his competency to perform these installations, or to supervise their installation, repair or maintenance as provided by the regulations of the District.

111.2 Nonconforming work. A person, firm or corporation engaged in the business regulated by this Code, whose workmanship and materials do not conform to the requirements of this Code, shall, on notice from the Chief Mechanical Inspector,

make changes or corrections necessary to comply with the code requirements. If the work has not been changed within 10 days after receiving a written notice, the Chief Mechanical Inspector shall refuse to issue additional permits until the installation complies with the code requirements.

SECTION 112 VALIDITY

112.1 Applicability. If a section, subsection, sentence, clause or phrase of this Code is held to be unconstitutional or illegal, such decision shall not affect the validity of other sections, subsections, sentences, clauses or phrases of this Code.

CHAPTER 2

DEFINITIONS

SECTION 201 GENERAL

201.1 Scope. For the purpose of this Code, certain abbreviations, terms, phrases, words and their derivatives shall be construed as set forth in this Chapter.

201.2 Tense, gender and number. Words used in the present tense include the future. Words in the masculine gender include the feminine and neuter. Words in the feminine and neuter gender include the masculine. The singular number includes the plural and the plural number includes the singular.

201.3 Words not defined. Words not defined herein shall have the meanings stated in the *EPCOT Building Code*, the *EPCOT Plumbing Code*, the *EPCOT Fuel Gas Code* or the *EPCOT Fire Prevention Code*. Words not defined in the EPCOT codes shall have the meanings stated in *Merriam-Webster's Tenth New Collegiate Dictionary*, as revised.

SECTION 202 DEFINITIONS

ABSORPTION SYSTEM. A refrigerating system in which refrigerant is pressurized by pumping a chemical solution of refrigerant in absorbent and then separated by the addition of heat in a generator, condensed (to reject heat), expanded, evaporated (to provide refrigeration), and reabsorbed in an absorber to repeat the cycle; the system may be single or multiple effect, the latter using multiple stages or internally cascaded use of heat to improve efficiency.

ACCESSIBLE. Having access to, but which first may require the removal of, a panel, door or similar covering of the item described. (See "Readily accessible.")

ACTIVE SYSTEM. A solar heating or cooling system using circulated liquid, air or other fluid to transfer energy within a structure.

ADMINISTRATIVE AUTHORITY. The individual official, board, department or agency established and authorized by a state, county, city or other political subdivision created by law to administer and enforce the provisions of this Code as adopted or amended.

AGGREGATE AMOUNT OF HEAT INPUT. The total heat input, in British thermal units per hour (Btu/h), of all boilers connected to one common header, except that any boiler that is permanently blanked off and discontinued from service shall not be a factor in determining the "Aggregate Amount of Heat Input."

AIR. All air supplied to mechanical equipment for combustion, ventilation, cooling, etc. Standard air is air at standard temperature and pressure, namely 70°F and 29.92 inches of mercury.

AIR (FOR COMBUSTION). The amount of air required for the safe and proper combustion of fuel in fuel-fired appliances.

AIR CONDITIONING. The process of treating air to control its temperature, humidity, cleanliness and distribution to meet the requirements for the conditioned space.

AIR-CONDITIONING SYSTEM. Consists of heat exchangers, blowers, filters, supply exhaust and return ducts, and shall include any apparatus installed in connection therewith.

AIR DISTRIBUTION SYSTEM. Any system of ducts, plenums and air-handling equipment that circulates air within a space or spaces and includes systems made up of one or more air-handling units.

AIR DUCT. A conduit or passageway for conveying air to or from heating, cooling, air-conditioning or ventilating equipment, but not including the plenum.

AIR DUCT MATERIAL.

Class 0. Air duct materials and connectors having a fire hazard classification of zero (flame spread and smoke developed).

Class 1. Air duct materials and connectors having a flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke-developed rating of not more than 50.

Class 2. Air duct materials and connectors having a flame spread rating of not more than 50 without evidence of continued progressive combustion, and a smoke-developed rating of not more than 50 for the inside surface and not more than 100 for the outside surface.

AIR WASHER. Water spray system or device for cleaning, humidifying or dehumidifying the air.

ALTERATION. A change in an air-conditioning, heating, ventilating or refrigeration system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

AND/OR. In a choice of two code provisions, signifies that the use of both provisions will satisfy the code requirement and the use of either provision is acceptable also.

APPLIANCE. Utilization equipment normally built in standardized sizes that is installed or connected as a unit to perform one or more functions.

APPLIANCE TYPE.

High-heat appliance. Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature greater than 2,000°F.

DEFINITIONS

Low-heat appliance (residential appliance). Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of 1,000°F.

Medium-heat appliance. Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature greater than 1,000°F, but not greater than 2,000°F.

APPROVED. Approved by the Chief Mechanical Inspector or other authority having jurisdiction.

ATTIC FAN. Generally, propeller-type fans used during summer to draw cool night air through the structure and discharge into the attic where it escapes through louvers, soffit vents or ridge vents to the exterior of the building.

BOILER. Any vessel used for generating steam or hot water to be used external to the vessel, which exceeds any of the following limitations:

- (a) A heat input capacity of 200,000 Btu/h.
- (b) A water temperature of 210°F.
- (c) A nominal water capacity of 120 gallons.

BOILER, HEATING (LOW-PRESSURE). Hot water boilers operating at pressures not in excess of 160 pounds per square inch (psi) and 250°F, or steam boilers operating at pressures not in excess of 15 psi, used for heating buildings or structures. (See also “High pressure” and “Low pressure.”)

BRAZED JOINT. A gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys that melt at a temperature greater than 1,000°F, but less than the melting temperature of the parts to be joined.

BREECHING (FLUE CONNECTION). A passage for conducting the products of combustion from a fuel-fired appliance to the vent or chimney. (See also “Chimney connector” and “Vent connector.”)

BRIDGE WALL. A partition wall between chambers over which pass the products of combustion.

BRINE. A liquid used for the transmission of heat without a change in its state, having no flash point or a flash point greater than 150°F as determined in an approved manner.

BRITISH THERMAL UNIT (BTU). The quantity of heat required to raise 1 pound of water 1°F (at or near 39.2°F and at atmospheric pressure at sea level).

BUILDING USE GROUP CLASSIFICATIONS. The arrangement of buildings in classes according to use and occupancy, as set forth in the *EPCOT Building Code*.

BURNER. A device for the final conveyance of fuel or a mixture of fuel and air to the combustion zone.

CAPACITY. The quantity or volume as produced or delivered by an air-conditioning, refrigeration, heating, air-handling or exhaust system.

- (a) Air-conditioning or refrigeration capacity expressed in Btu/h or tons of refrigeration.
- (b) Heating capacity expressed in Btu/h or boiler evaporation rate (lb/h).

- (c) Air-handling or exhaust expressed in cubic feet per minute (cfm).

CEILING RADIATION DAMPER. A listed device installed in a ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly to limit automatically the radiative heat transfer through an air inlet/outlet opening.

CHIMNEY. A primarily vertical enclosure containing one or more passageways.

High-heat-type appliance. An approved chimney for removing the products of combustion from fuel-burning, high-heat appliances producing combustion gases in excess of 2,000°F measured at the appliance flue outlet.

Low-heat-type appliance. An approved chimney for removing the products of combustion from fuel-burning, low-heat appliances producing combustion gases not in excess of 1,000°F under normal operating conditions, but capable of producing combustion gases of 1,400°F during intermittent forced firing for periods not greater than 1 hour. All temperatures shall be measured at the appliance flue outlet.

Medium-heat-type appliance. An approved chimney for removing the products of combustion from fuel-burning, medium-heat appliances producing combustion gases not in excess of 2,000°F measured at the appliance flue outlet.

Residential-type appliance. An approved chimney for removing products of combustion from residential-type appliances producing combustion gases not in excess of 1,000°F measured at the appliance flue outlet.

CHIMNEY CONNECTOR. The pipe that connects a fuel appliance to a chimney. (See “Breeching.”)

CHIMNEY, FACTORY-BUILT. A chimney that is factory made, listed by an accredited testing agency for venting gas appliances, incinerators, and solid or liquid fuel-burning appliances.

CHIMNEY, MASONRY. A field-constructed chimney of solid masonry units, stones, listed hollow masonry units or reinforced concrete built in accordance with nationally recognized standards.

CHIMNEY, METAL. Field-constructed chimney made of metal that is corrosion resistant and built in accordance with nationally recognized standards.

COLLECTOR PLATE. The component of a solar collector that transfers the heat from solar energy to a circulating fluid.

COMBINATION SMOKE AND FIRE DAMPER. A listed device that meets the requirements of UL 555 and UL 555S, and is designed to resist the passage of fire and smoke.

COMBUSTIBLE MATERIAL. Any material not defined as noncombustible.

COMBUSTION. The rapid oxidation of fuel accompanied by the production of heat, or heat and light.

COMBUSTION CHAMBER. The space in a heating appliance provided for the combustion of fuel.

COMBUSTION CHAMBER, PRIMARY (INCINERATOR). The chamber within an incinerator where primary ignition and burning of waste occurs.

COMBUSTION CHAMBER, SECONDARY (INCINERATOR). The chamber where unburned combustible materials from the primary chamber are completely burned.

COMMERCIAL DUCT. Systems serving spaces greater than 25,000 cubic feet.

COMPRESSOR. A specific machine, with or without accessories, for compressing a given refrigerant vapor.

COMPRESSOR UNIT. A condensing unit less the condenser and liquid receiver.

CONDENSATE. The liquid that separates from a gas (including flue gases) due to a reduction in temperature.

CONDENSATE DISPOSAL SYSTEM. A system consisting of a drip pan, connecting piping and other components that provides for the collection and discharge, in a suitable and reliable manner, of all condensate precipitated by the cooling coils or evaporators.

CONDENSER. A vessel or arrangement of pipe or tubing in which vaporized refrigerant is liquefied by the removal of heat.

CONDENSING FURNACE. A furnace or boiler that condenses part of the water vapor generated by the burning of hydrogen in fuels, and one in which the fraction of the total latent heat remaining in the flue gases after condensation is less than one.

CONDENSING UNIT. A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

CONFINED SPACE. A space whose volume is less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all appliances installed in that space.

DIRECT-VENT APPLIANCES. Appliances that are so constructed and installed that all air for combustion is derived from, and all flue gases are discharged to, the outside atmosphere.

DRY CLEANING SYSTEMS. Dry cleaning plants or systems are classified as follows:

Type I. Those systems using Class I flammable liquid solvents having a flash point that is less than 100°F.

Type II. Those systems using Class II combustible liquid solvents having a flash point greater than or equal to 100°F and that is less than 140°F.

Type III. Those systems using Class III combustible liquid solvents having a flash point greater than or equal to 140°F.

Types IV and V. Those systems using Class IV nonflammable liquid solvents.

DRYING HEARTH. A surface within the primary chamber upon which wet waste material is deposited for drying prior to burning.

DUCT COVERINGS. Includes materials, such as adhesive, insulation, banding, coating(s), film and jacket, used to cover the outside surface of a duct, fan casing or duct plenum.

DUCT LINING. Includes materials, such as adhesive, insulation, coating and film, used to line the inside surface of a duct, fan casing or duct plenum.

DUCT MATERIAL. See “Air duct material.”

DUCT SYSTEM. A continuous passageway for the transmission of air, which, in addition to ducts, may include duct fittings, dampers, plenums, fans and accessory air-handling equipment.

ELECTRIC SPACE HEATERS, PORTABLE. Heaters not intended for permanent connection to a structure or electric wiring.

ELECTRIC SPACE HEATERS, STATIONARY. Heaters permanently mounted in a structure (air duct system) and that are permanently connected to electric wiring.

ENVIRONMENTAL AIR. Air that is conveyed to or from occupied areas through ducts which are not part of the heating or air-conditioning system, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust, domestic clothes dryer exhaust and parking garage exhaust.

EVAPORATOR. That part of the system in which liquid refrigerant is vaporized to produce refrigeration.

EXHAUST SYSTEM. An assembly of connected ducts, plenums, fittings, registers, grilles and hoods, through which air is conducted from the space or spaces and exhausted to the outside atmosphere.

FILTER, AIR. A device used to remove air-borne solids from heating, ventilating or air-conditioning duct systems.

FIRE DAMPER. A listed device that meets the requirements of UL 555 and is designed to close automatically upon detection of heat. Closure shall interrupt any migratory airflow and restrict the passage of flame.

FLAME SAFEGUARD. A device that will automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of such burners become inoperative.

FLAME SPREAD RATING. The numerical value assigned to a material tested in accordance with ASTM E84.

FLUE CONNECTION (BREECHING). A passage for conducting the products of combustion from a fuel-fired appliance to a vent or chimney. (See also “Chimney connector” and “Vent connector.”)

FURNACE. A completely self-contained unit that produces heat by utilizing electric energy or by burning fuel.

FURNACE, CENTRAL. A self-contained, indirect-fired or electrically heated appliance designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.

GENERATOR. Any device equipped with a heating element used in the refrigerating system to increase the pressure of refrigerant in its gas or vapor state for the purpose of liquefying the refrigerant.

DEFINITIONS

GROUND SOURCE HEAT PUMP LOOP SYSTEM. Piping buried in horizontal or vertical excavations, or placed in a body of water, for the purpose of transporting heat transfer liquid to and from a heat pump. Included in this definition are closed-loop systems in which the liquid is recirculated and open-loop system in which the liquid is drawn from a well or other source.

HEAT EXCHANGER. A device used for the transfer of heat from one medium to another.

HEATER, ROOM (SPACE). A free-standing heating unit burning solid, liquid or gas fuel for direct heating of the space in and adjacent to that in which the unit is located.

HEATING SYSTEM, CENTRAL WARM AIR. A heating system consisting of an air-heating appliance from which the heated air is distributed by means of ducts, pipes or plenums, including any accessory apparatus and equipment installed in connection therewith.

HIGH PRESSURE (AND TEMPERATURE).

Hot water. Any boiler, generator, pressure vessel, system, piping or equipment used for purposes of heating or distributing hot water for heating or processing, operating at pressures in excess of 160 psi and temperatures in excess of 250°F.

Steam. Any boiler, generator, pressure vessel, system, piping or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressures of 15 psi or more.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH). The concentration of airborne contaminants that poses a threat of death, immediate or delayed permanent adverse health effects, or effects that could prevent escape from such an environment. This contaminant concentration level is established by the National Institute of Occupational Safety and Health (NIOSH) based on both toxicity and flammability. It is generally expressed in parts per million by volume (ppm v/v) or milligrams per cubic meter (mg/m³).

INSOLATION. The total amount of solar energy reaching a surface per unit of time.

INTERLOCK. A device actuated by another device with which it is directly associated, to govern succeeding operations of the same or allied devices. A circuit in which a given action cannot occur until after one or more other actions have taken place.

LABELED. Devices, equipment or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains the periodic inspection of the production of the labeled items and by whose label the manufacturer attests to compliance with applicable nationally recognized standards.

LANGLEY. Standard unit of insolation, 1 langley/minute = 221 Btu/h/ft².

LFL (LOWER FLAMMABILITY LIMIT). The minimum concentration of refrigerant that is capable of propagating a flame through a homogeneous mixture of refrigerant and air.

LIMITED CHARGE SYSTEM. A system in which, with the compressor idle, the design pressure will not be exceeded when the refrigerant charge has completely evaporated.

LISTED. Equipment or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains the periodic inspection of the production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner. The means for identifying listed equipment may vary for each testing laboratory, inspection agency or other organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

LOW PRESSURE (AND TEMPERATURE).

Hot water. Any boiler, generator, pressure vessel, system, piping or equipment used for the purposes of heating or distributing hot water for heating or processing, operating at pressures of 160 psi and temperatures of 250°F or less.

Steam. Any boiler, generator, pressure vessel, system, piping or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressures of 15 psi or less.

MASONRY UNIT, SOLID. A masonry unit whose net cross-sectional area in every plane parallel to the bearing surface is 75 percent or more of its gross cross-sectional area measured in the same plane.

MECHANICAL DRAFT SYSTEM. A venting system designed to remove flue or vent gases by mechanical means, which consists of an induced-draft portion under nonpositive static pressure or a forced-draft portion under positive static pressure.

Forced-draft venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static pressure.

Induced-draft venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under nonpositive static vent pressure.

Power venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static vent pressure.

MECHANICAL INSPECTOR, CHIEF. See “Administrative authority”.

MINIATURE BOILER. Any power boiler that does not exceed the following limits:

- (a) An inside shell diameter of 16 inches.
- (b) A heating surface of 20 square feet (not applicable to electric boiler).
- (c) A gross volume of 5 cubic feet.
- (d) A maximum allowable working pressure of 100 psi.

NONCOMBUSTIBLE MATERIAL. A material that meets either of the requirements in Paragraphs (a) or (b). The term “noncombustible” does not apply to the flame spread characteristics of interior finish or trim materials. No material shall be classed as a noncombustible building material that is subject to increases in combustibility or flame spread beyond the limits herein established through the effects of age, moisture or other atmospheric conditions.

- (a) Materials that pass the test procedure set forth in ASTM E136.
- (b) Materials having a structural base of noncombustible material as defined in Paragraph (a), with a surfacing of not greater than $\frac{1}{8}$ inch thick that, in addition, has a flame spread rating not greater than 50 when tested in accordance with the ASTM E84.

OCCUPANCY. The purpose for which a building, or portion thereof, is utilized or occupied.

PACKED BED STORAGE. Heat capacity storage in a bed of packed solid material, usually rock.

PANEL HEATING. A method of radiant space heating in which heat is supplied by large heated areas of room surfaces. The heating element usually consists of warm water piping, warm air ducts or electrical resistance elements embedded in or located behind ceiling, wall or floor surfaces.

PHOTOVOLTAIC CONVERSION. Use of a semiconductor or other photovoltaic device that converts solar radiation directly to electricity.

PLENUM. An enclosed portion of the building structure, other than an occupiable space being conditioned, that is designed to allow air movement, and thereby serve as part of an air distribution system.

PORTABLE BOILER. A boiler that is primarily intended for a temporary location, and the construction and usage of which is obviously portable.

PORTABLE COOLING UNIT. A self-contained refrigerating system, with not greater than a 3-horsepower rating, that has been factory assembled and tested, and installed without connecting any refrigerant-containing parts. This definition shall not include an absorption unit.

PORTABLE EVAPORATIVE COOLER. Any evaporative cooler that discharges the conditioned air without the use of ducts and can be readily transported from place to place without dismantling any portion thereof.

PORTABLE HEATING APPLIANCE. Any approved, unvented air-heating appliance designed for environmental heating that is not secured or attached to a building by any means other than by fuel piping or electrical wiring.

PORTABLE VENTILATING EQUIPMENT. Any ventilating equipment that can be readily transported from place to place without dismantling any portion thereof and is not connected to a duct.

READILY ACCESSIBLE. Having direct access without the need of removing any panel, door or similar covering of the item described, and without requiring the use of portable ladders, chairs, etc.

REFRIGERANT. The fluid used for heat transfer in a refrigerating system; the refrigerant absorbs heat and transfers it at a higher temperature and/or pressure, usually with a change of state.

REFRIGERANT SAFETY CLASSIFICATIONS. The safety classification is made up of a letter (A or B) that indicates the toxicity class, followed by a number (1, 2 or 3) that indicates the flammability class. Refrigerant blends are similarly classified based on the compositions at their worst cases of fractionation, as separately determined for toxicity and flammability. In some cases, the worst case of fractionation is the original formulation.

Flammability. Class 1 indicates refrigerants that do not show flame propagation in the air when tested by prescribed methods at specified conditions. Classes 2 and 3 signify refrigerants with “lower flammability” and “higher flammability,” respectively; the distinction depends on both the LFL and heat of combustion.

Toxicity. Classes A and B signify refrigerants with “lower toxicity” and “higher toxicity,” respectively, based on prescribed measures of chronic (long-term, repeated exposures) toxicity.

SAFETY GROUP^a

	LOWER TOXICITY	HIGHER TOXICITY
Higher flammability	A/3	B/3
Lower flammability	A/2	B/2
No flame propagation	A/1	B/1

- a. Blends, whose flammability and/or toxicity characteristics may change as the composition changes during fractionation, are assigned a dual safety group classification, with the two classifications separated by a slash (/). The first classification listed is the classification of the as-formulated composition of the blend. The second classification listed is the classification of the blend at the worst case of fractionation.

REFRIGERATING SYSTEM. A combination of interconnected parts forming a closed circuit in which refrigerant is circulated for the purpose of extracting, then rejecting heat. See Section 1102 for the classification of refrigeration systems by type.

Direct. A system in which the evaporator or condenser of the refrigeration system is in direct contact with the air or other substances to be cooled or heated.

Indirect. A system in which a secondary coolant, cooled or heated by the refrigerant, is circulated to the air or other substance to be cooled or heated. Indirect systems are distinguished by the following methods of application:

Double indirect open spray system. A system in which the secondary substance for an indirect open spray system is heated or cooled by an intermediate coolant circulated from a second enclosure.

Indirect closed system. A system in which a secondary fluid is either cooled or heated by the refrigeration system, and then circulated within a closed circuit in indirect contact with the air or other substance to be cooled or heated.

DEFINITIONS

Indirect open spray system. A system in which a secondary coolant is cooled or heated by the refrigeration system, and then circulated in direct contact with the air or other substance to be cooled or heated.

Indirect vented closed system. A system in which a secondary coolant is cooled or heated by the refrigeration system, and then passes through a closed circuit in the air or other substance to be cooled or heated, except that the evaporator or condenser is placed in an open or appropriately vented tank.

REFRIGERATION SYSTEM CLASSIFICATION.

Refrigeration systems are classified according to the degree of probability, low or high, that leaked refrigerant from a failed connection, seal or component could enter an occupied area. The distinction is based on the basic design and location of the components.

High-probability system. Any refrigeration system in which refrigerant from a failed connection, seal or component could enter an occupancy classified area, other than a machinery room.

Low-probability system. Any refrigeration system in which refrigerant from a failed connection, seal or component cannot enter an occupancy classified area, other than a machinery room.

REPAIR. The reconstruction or renewal of any part of an existing mechanical system for the purpose of its maintenance.

RESIDENTIAL DUCT. Systems serving one- and two-family dwellings and spaces of 25,000 cubic feet and less.

RETURN AIR SYSTEM. An assembly of connected ducts, plenums, fittings, registers and grilles through which air from the space or spaces to be heated or cooled is conducted back to the supply unit. (See also "Supply air system.")

SELF-CONTAINED EQUIPMENT. Complete, factory assembled and tested. Heating, air-conditioning or refrigeration equipment installed as a single unit, and having all working parts, complete with motive power, in an enclosed unit of said machinery.

SMOKE DAMPER. A listed device that meets the requirements of UL 555S and is designed to resist the passage of air and smoke. The device is arranged to operate automatically, controlled by a smoke detection system, and may be capable of being positioned manually from a remote command station.

SMOKE-DEVELOPED RATING. A numerical value assigned to a material tested in accordance with ASTM E84.

SOLAR COLLECTOR. Any device or assembly of components that collects solar energy and uses such energy directly, or transforms it to another usable form of energy.

SOLAR CONCENTRATOR. A reflective surface or refracting lens for directing insolation onto the absorber surface.

SOLAR CONSTANT. The insolation on a surface in space at the earth's distance from the sun, 428 Btu/h/ft².

SOLAR COVER PLATE. A transparent plastic, glass plate or other material placed over the absorber plate of a solar collector to avoid heat losses and weathering of the absorber plate.

SOLAR ENERGY. The radiant energy of the sun in the form of direct, diffuse or reflected radiation.

SOLAR ENERGY SYSTEM. Any system using solar energy as defined by "Solar energy."

SOLAR MEDIUM. The material in an assembly used for storing solar energy in its transformed state, be it thermal or electrical.

SOLDERED JOINT. A gas-tight joint obtained by the joining of metal parts with metallic mixtures of alloys that melt at temperatures between 400°F and 800°F.

SOLID FUEL (COOKING APPLICATIONS). Applicable to commercial food-service operations only, solid fuel is any bulk material, such as hardwood, mesquite, charcoal or briquettes, that is combusted to produce heat for cooking operations.

SUPPLY AIR SYSTEM. An assembly of connected ducts, plenums, fittings, registers and grilles through which air, heated or cooled, is conducted from the supply unit to the space or spaces to be heated or cooled. (See also "Return air system.")

TLV-TWA (THRESHOLD LIMIT VALUE-TIME WEIGHTED AVERAGE). The time-weighted average concentration of a refrigerant or other chemical in the air for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects [adopted by the American Conference of Government Industrial Hygienists (ACGIH)].

TOILET ROOM. A room containing a water closet and, frequently, a lavatory, but not a bathtub, shower, spa or similar bathing fixture.

UNCONFINED SPACE. A space whose volume is not less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all appliances installed in that space. Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

UNUSUALLY TIGHT CONSTRUCTION. Construction meeting the following requirements:

- (a) Walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder with a rating of 1 perm or less with openings gasketed or sealed;
- (b) Storm windows or weatherstripping on openable windows and doors; and
- (c) Caulking or sealants applied to areas such as joints around window and door frames; between sole plates and floors; between wall-ceiling joints; between wall panels; at penetrations for plumbing, electrical and gas lines; and at other openings.

VENT. A passageway for conveying flue gases from fuel-burning appliances or their vent connectors to the outside atmosphere.

VENT CONNECTOR. The pipe used to connect an approved fuel-fired appliance to a chimney or vent. (See also “Flue connection.”)

VENTILATION. The process of supplying or removing air by natural or mechanical means to or from any space.

VENTILATION SYSTEM. A mechanical or gravity system installed and operated in such a manner as to secure, with normal operation, the standard of ventilation required by this Code.

VENTS, TYPES.

Single-metal wall vents. Vents constructed of sheet copper of not less than No. 24 gage or galvanized steel of not less than 0.0396 inch; or other approved, noncombustible, corrosion-resistant material.

Type B vents. Factory-made vents listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn only gas.

Type BW vents. Factory-made vents listed by a nationally recognized testing agency for venting listed or approved gas-fired, vented wall furnaces.

Type L vents. Factory-made vents listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn gas or oil.

WHOLE-HOUSE FAN. See “Attic fan.”

CHAPTER 3

GENERAL REQUIREMENTS

SECTION 301 GENERAL

301.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of equipment used in systems pertaining to heating, ventilation, air conditioning (space cooling) and refrigeration.

301.2 Approval. All listed equipment shall be installed in accordance with its listing, and the equipment shall be labeled accordingly, including the seal or mark of the testing agency that certified the listing. All unlisted equipment shall be installed in accordance with this Code.

301.3 Structural safety.

301.3.1 General. In the process of installing or repairing any heating, ventilation and air-conditioning (HVAC) equipment, the finished floors, walls, ceilings, tile work or any other part of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the *EPCOT Building Code*.

301.3.2 Cutting, notching and bored holes.

301.3.2.1 Joist notching. Notches on the ends of joists shall not exceed one-fourth the depth. Holes bored for pipes or cable shall not be within 2 inches of the top or bottom of the joist, and the diameter of any such hole shall not exceed one-third of the depth of the joist. Notches for pipes in the top or bottom of joists shall not exceed one-sixth of the depth and shall not be located in the middle one-third of the span.

301.3.2.2 Stud cutting and notching. In exterior walls and bearing partitions, any wood stud shall be cut or notched to a depth not exceeding 25 percent of its width. Cutting or notching of studs to a depth not greater than 40 percent of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

301.3.2.3 Bored holes. A hole not greater in diameter than 40 percent of the stud width may be bored in any wood stud. Bored holes not greater than 60 percent of the width of the stud are permitted in nonbearing partitions or in any wall where each bored stud is doubled, provided not greater than two such successive double studs are bored. In no case shall the edge of the bored hole be nearer than $\frac{5}{8}$ inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

301.4 Structural supports.

301.4.1 Seismic resistance. Where earthquake loads are applicable according to the *EPCOT Building Code*, mechanical equipment, piping and duct supports shall be designed and installed for the seismic forces in accordance with the *EPCOT Building Code*.

301.4.2 Hanging and supports. All piping shall be supported in compliance with the current manufacturer's recommendations and Table 301.4.

301.4.3 Attachments. Upper attachments for duct and pipe hangers shall attach vertically to the structure. Upper structural attachments shall not be cantilevered. Pipe and duct supports shall transmit the load downward at not less than a 45-degree angle.

Exception: Signed and sealed engineered hanger and support systems approved by the Chief Mechanical Inspector.

**TABLE 301.4
PIPING SUPPORT**

PIPING MATERIALS	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
ABS pipe	4	10 ^b
Aluminum pipe and tubing	10	15
Brass pipe	10	10
Brass tubing, 1 $\frac{1}{4}$ -inch diameter and smaller	6	10
Brass tubing, 1 $\frac{1}{2}$ -inch diameter and larger	10	10
Cast-iron pipe ^a	5	15
Copper or copper-alloy pipe	12	10
Copper or copper-alloy tubing, $\frac{1}{2}$ -inch diameter and larger	10	10
Copper or copper-alloy tubing, 1 $\frac{1}{4}$ -inch diameter and smaller	6	
CPVC pipe or tubing, 1-inch diameter and smaller	3	10 ^b
CPVC pipe or tubing, 1 $\frac{1}{4}$ -inch diameter and larger	4	10 ^b
Lead pipe	Continuous	4
PB pipe or tubing	2 $\frac{2}{3}$ (32 inches)	4
PEX tubing	2 $\frac{2}{3}$ (32 inches)	10 ^b
PVC pipe	4	10 ^b
Steel pipe	12	15
Steel tubing	8	10

a. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.

b. Mid-story guide.

GENERAL REQUIREMENTS

301.5 Rotating equipment protection. All mechanical equipment shall be provided with guards or protectors with screens or gratings of not greater than $\frac{1}{2}$ -inch mesh over the rotating parts to prevent accidents.

301.6 Chilled, steam and hot water piping, gas piping. Piping systems in which chilled or hot water is transported for heating, air conditioning or refrigerating shall be fabricated and installed in accordance with Chapter 12. Gas piping shall conform to the *EPCOT Fuel Gas Code*.

301.6.1 Welder certification. Pipe welders shall be certified under Section IX of ASME *Boiler and Pressure Vessel Code*. Test coupons shall be Schedule 40 pipe welded in the 6G position.

301.7 Duct systems. Design, construction and installation of air ducts shall comply with Chapter 6.

301.8 Mechanical refrigeration. All refrigeration equipment used as a portion of air-conditioning equipment shall comply with Chapter 11.

301.9 Electrical connections. Electric comfort heating appliances shall be connected in accordance with Section 308.

301.10 Changing refrigerant. A change in the number designation of refrigerant in a system shall not be made without the permission of the Chief Mechanical Inspector; the user; and, after appropriate consideration of and with consultation with the manufacturers of the original equipment, due observance of safety requirements.

301.11 Corrosive atmospheres. Pipe and duct systems supplying or passing through corrosive atmospheres shall be constructed of corrosive-resistant materials as approved by the Chief Mechanical Inspector.

301.11.1 Equipment listings. Mechanical equipment installed in atmospheres that are corrosive shall be listed and rated for that exposure.

301.12 Mechanical equipment room. Mechanical equipment shall be located in rooms or spaces dedicated to such equipment. No equipment, or use of such room or space foreign to mechanical equipment, shall be permitted without the permission of the Chief Mechanical Inspector. A durable sign with letters not less than $\frac{1}{2}$ inch high shall be mounted on the outside of the door reading: "MECHANICAL EQUIPMENT—NO STORAGE PERMITTED."

SECTION 302 HVAC AND REFRIGERATION EQUIPMENT

302.1 Labeling. A permanent factory-applied nameplate shall be affixed to equipment on which shall appear, in legible lettering, the manufacturer's name or trademark, model, serial number, and seal or mark of the testing agency. A label shall also include the following:

- (a) **Electrical equipment.** Electrical rating, in volts, amperes and motor phase; identification of individual electrical components, in volts, amperes or watts, motor phase; Btu output; and required clearance, if clearances are specified.

- (b) **Absorption units.** Hourly rating, in Btu; minimum hourly rating for units having step or automatic modulating controls; type of fuel; type of refrigerant; cooling capacity, in Btu; and required clearance, if clearances are specified.

- (c) **Fuel-burning units.** Hourly rating, in Btu; type of fuel approved for use with the appliance; and required clearances, if clearances are specified.

- (d) **Heating, cooling and refrigeration appliances.** Name and trademark of the manufacturer; the catalog (model) number or equivalent; the electric rating in volts, amperes and phase; Btu output rating; amount and type of refrigerant; design pressures applied; individual marking for each electrical component, in amperes or watts, volts and phase; required clearances from combustibles; and a seal indicating approval of the appliance by an approved testing agency.

302.2 Manufacturer's operating instructions. Permanent factory-applied instructions for ignition, operation and shut-down shall accompany the equipment. The manufacturer's operating instructions shall remain attached to the appliance in a position to be easily read during the life of the appliance.

302.3 Listed equipment. When the requirements for listed appliances and their accessories are different from the requirements of this Section, such listed appliances shall be installed in accordance with the conditions specified in their listing. Listed appliances and their accessories, installed or used not in accordance with the conditions specified in their listing and all appliances not listed shall conform to the requirements of this Section.

302.4 National standards. Unless otherwise specified in this Chapter, air-conditioning equipment shall comply with the following standards:

- (a) ANSI/ASHRAE 15, *Safety Code for Mechanical Refrigeration*.
- (b) ASHRAE Handbook, *HVAC Systems and Equipment*.
- (c) NFPA 90A, *Installation of Air-Conditioning and Ventilating Systems*.
- (d) NFPA 90B, *Installation of Warm-Air Heating and Air-Conditioning Systems*.
- (e) NFPA 214, *Water-Cooling Towers*.

302.5 Electric duct heater safety controls. Electric duct heaters shall be listed; bear the seal or mark of an approved testing agency; and be equipped with an approved automatic reset, air outlet temperature limit control that will limit the outlet air temperature to not greater than 200°F. The electric elements of the heater shall be equipped with fusible links or a manual reset temperature limit control that will prevent outlet air temperature in excess of 250°F.

302.6 Equipment installed outdoors. Heating and cooling equipment, when installed outdoors, shall be listed for such use in accordance with UL 1955.

302.7 Accessibility for service.

302.7.1 Access for maintenance and replacement. Every appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit the cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls and vent connections; the lubrication of moving parts where required; and the adjustment and cleaning of burners and pilots.

302.7.2 Outdoor locations. Appliances listed for outdoor installations may be installed without protection in accordance with the provisions of their listing and shall be accessible for servicing. Appliances listed “for outdoor installation only” shall not be installed inside a building.

302.7.3 Appliances in rooms. Where an appliance is located in an equipment room, such room shall have an opening or door and passageway thereto, which is large enough to permit the removal of the largest piece of the appliance, but not less than 22 inches wide.

302.7.4 Elevated equipment. All mechanical equipment installed indoors at a height greater than 20 feet above the applicable finished floor shall be accessible.

Exception: When the equipment is less than 20 feet above the applicable finished floor, a portable means of access is acceptable.

302.8 Location restrictions.

302.8.1 Central furnaces. Central furnaces (using solid, liquid or gas fuel), except direct-vent or heating coils located in air-handling units, shall not be installed:

- (a) Under a stairway.
- (b) In a room used as a bedroom, bathroom, or in a closet with access only through a bedroom or bathroom.

Exception: When a closet, having a weather-stripped, solid door with an approved door-closing device, has been designed exclusively for the central furnace, and where all air for combustion and ventilation is supplied from outdoors.

302.8.2 Refrigeration system components.

302.8.2.1 Shafts. No portion of any refrigerating system shall be located in any elevator shaft, dumbwaiter shaft or any shaft having moving objects therein.

302.8.2.2 Exit access. No portion of a refrigerating system shall interfere with free passage through exit access corridors, and a refrigerating system installed in an exit access corridor or lobby shall be limited to:

- (a) Unit systems containing not more than the amount of Group A/1 refrigerant as specified in Tables 1102 and 1103A; or
- (b) Sealed absorption systems as specified in Table 1103B.

302.8.2.3 Exits. No portion of a refrigerating system shall be installed in or on an exit stairway, stair landing, entrance, exit or exit discharge.

302.9 Attic installation.

302.9.1 Appliances in attics. Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment, and in no case less than 22 inches by 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 feet from the equipment measured along the centerline of such passageway. Every passageway shall be unobstructed and shall have solid continuous flooring of not less than 24 inches wide from the entrance opening to the equipment. On the control side, and other sides where access is necessary for servicing the equipment, a level working platform extending a minimum of 30 inches from the edge of the equipment with a 36-inch-high clear working space shall be provided. Top or bottom service equipment shall have full clearance above or below the unit for component removal.

302.10 Under-floor and exterior-grade installations.

302.10.1 Appliances under floors. All mechanical equipment installed in the under-floor area of any building shall comply with the following requirements:

- (a) An access opening and passageway of a height and width sufficient to permit the removal of the mechanical equipment, and in no case less than 36 inches by 22 inches shall be provided to the working space in front of the mechanical equipment. The access opening to any such passageway shall be through an opening in an exterior wall of the building or through a trap door within the building. Where access is necessary for servicing the equipment, a level working grade or platform extending a minimum of 30 inches from the edge of the equipment with a 36-inch-high clear working space shall be provided. The distance from the passageway access to the heating equipment shall not exceed 20 feet.
- (b) All mechanical equipment supported from the ground shall rest on a concrete slab extending not less than 3 inches above the adjoining ground level.
- (c) The lowest portion of mechanical equipment suspended from the building shall have a minimum clearance of 6 inches from the ground.
- (d) Whenever it is necessary to excavate to install any such mechanical equipment, the excavation shall extend to a depth of 6 inches below the mechanical equipment and 12 inches on all sides of the mechanical equipment, except the control side, which shall have a clearance of 30 inches.
- (e) Whenever the excavation for either the mechanical equipment space or the passageway exceeds a depth of 12 inches, the walls of such excavation shall be lined with waterproof concrete or masonry, extending to a height of 4 inches above the adjoining ground level.
- (f) In flood plain areas, wherever there is a possibility that water may overflow the 4-inch-high curb, the entire crawl space grade or height shall be such that

GENERAL REQUIREMENTS

a 12-inch clearance will exist between the bottom of the mechanical equipment and the ground.

302.10.2 Clearances from grade. All mechanical equipment installed on exterior grade shall comply with the following requirements:

- (a) A minimum height of 36 inches and a depth of 30 inches shall be provided to the working space in front of the mechanical equipment.
- (b) All mechanical equipment shall rest on a 3-inch, cast-in-place slab or approved reinforced, prefabricated slab not less than 3 inches above finished grade.

302.11 Roof or exterior wall installation.

302.11.1 Equipment on roofs. Mechanical equipment installations on roofs or exterior walls of buildings shall comply with the requirements for roof and wall structures as specified in the *EPCOT Building Code*, and shall be listed and approved for such use. The wind-load requirements of Section 904 of the *EPCOT Building Code* shall apply to all exterior installations.

302.11.2 Sloped roofs. Every appliance located on a roof of a building shall be installed on a substantially level platform. Whenever the roof has a slope greater than 3:12, a level working platform not less than 30 inches deep shall be provided in front of the entire firebox and control sides of the appliance. All sides of any working platform facing any portion of the roof edge below the platform shall be protected by a substantial railing 42 inches high with vertical rails not more than 21 inches apart, except that parapets a minimum of 24 inches high may be utilized in lieu of rails or guards. Required working platforms and railings may be omitted when access to the equipment is through a required roof scuttle and all of the following provisions are met:

- (a) The required scuttle is located immediately adjacent to the control side of the equipment unit.
- (b) All controls, filters, burners, fans and motors are accessible for service and repair within 2 feet of the edge of the equipment platform on the scuttle side.
- (c) The equipment platform is not more than 20 inches above the high side of the scuttle opening.
- (d) A substantial working platform not less than 30 inches by 30 inches shall be provided directly below the scuttle at a point not less than 30 inches or more than 32 inches below the high side of the scuttle opening.
- (e) Scuttles located on other than the roof-incline side of the equipment unit shall have their lids or trap doors hinged on the low side of the scuttle.

302.11.3 Equipment or appliances on exterior walls. Every appliance in or on an exterior wall of a building, which is so designed that the components are serviceable only from outside the building, shall be accessible. Every appliance located on the roof of any building shall be accessible.

Exception: When the roof or wall-mounted equipment is less than 20 feet above grade, the use of a portable means of access is acceptable.

302.12 Condenser and compressor units.

302.12.1 Foundations and supports. Foundations and supports for condensing units or compressor units shall be of substantial construction sufficient to support the load. When used, wood exposed to the weather shall be pressure treated or approved wood of natural resistance to decay in accordance with the *EPCOT Building Code*.

302.12.2 Service clearance. A minimum of 30 inches of clear space on the service side for inspection and servicing of condensing units or compressor units shall be provided. Condensing units or compressor units with enclosures shall be readily accessible for servicing and inspection.

302.12.3 Clearance from means of egress. In systems using Group A/2, A/3, B/2 or B/3 refrigerants, as defined in Section 202, the refrigerant compressor shall be located not less than 10 feet from any exit or exit access in any occupancy, unless separated by partitions of a minimum 1-hour fire resistance.

302.12.4 Ventilation requirements. Every room or space, other than a machinery room complying with the requirements of Chapter 11, in which any refrigerant-containing portion of a condensing unit is located, shall be provided with one of the following:

- (a) A permanent gravity ventilation opening of not less than 2 square feet total area, opening directly to the outside of the building, or extending to the outside of the building by continuous ducts; or
- (b) A mechanical exhaust system, for ventilation, arranged to provide a complete change of air in such a room or space a minimum of every 20 minutes, and to discharge to the outer air outside of the building.

302.13 Evaporators and cooling coils.

302.13.1 General. Condensate drain systems shall be provided for equipment containing evaporators or cooling coils. Condensate drain systems shall be designed, constructed and installed in accordance with this Subsection.

302.13.2 Seal. The condensate drain system shall provide a seal that prevents ingestion of air or other gas, through the condensate drip pan drain and overflow connections, from all outside sources, including the condensate disposal place, during all operating conditions.

302.13.3 Condensate disposal place. Condensate from all cooling coils or evaporators shall be piped from the drip pan outlet indirectly to the sanitary sewer.

302.13.4 Drainpipe materials and sizes. Components of the condensate disposal system shall be of galvanized steel; copper pipe or tubing; or straight (not coiled) pipe or tubing of polybutylene (PB), polyethylene (PE), acrylonitrile-butadiene-styrene (ABS) or polyvinyl chloride (PVC). All components shall be selected for the pressure and temperature rating of the installation. Drain piping, except for the trap, shall be straight (not coiled) tubing or pipe. Condensate waste and drain lines shall be not less than a $\frac{3}{4}$ -inch pipe size or $\frac{7}{8}$ -inch tubing size, and shall be carried full size from the drain pan connection to the condensate disposal place. When the drainpipes from more

than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with accepted engineering practice.

302.13.5 French drain. A French drain shall be approved by the Department of Planning and Engineering prior to construction.

302.13.6 Drain systems.

302.13.6.1 Auxiliary drain pans. Auxiliary drain pans shall be installed under all coils containing a liquid or gas on which condensation will occur; or units containing coils located in attic spaces, suspended ceiling spaces, furred spaces or any area where damage could occur to the building, building contents or building occupants due to an overflow of the equipment drain pan or a stoppage in the condensate drain piping. Auxiliary pans shall have a minimum depth of 1½ inches, and shall be not less than 3 inches larger than unit or coil dimensions in width and length, and shall be constructed of not less than 0.0276-inch galvanized sheet steel. A separate drain line shall be extended from this pan terminating at a conspicuous point to serve as an alarm that the regular drain is restricted. A water level detector or float switch to control overflow may be used in auxiliary drain pans in lieu of a drain line, when approved by the Chief Mechanical Inspector.

302.14 Refrigerant piping location.

302.14.1 Piping location. Refrigerant piping crossing an open space that affords passageway in any building shall be not less than 7 feet, 6 inches above the floor, unless the piping is located against the ceiling of such space.

302.14.2 Prohibited locations. Free passageway shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter or other shaft containing a moving object, or in any shaft that has openings to living quarters or to main exit hallways. Refrigerant piping shall not be placed in public hallways, lobbies or stairways, except that such refrigerant piping may pass across a public hallway if there are no joints in the section in the public hallway, and provided nonferrous tubing of 1-inch nominal diameter [1⅛-inch outside diameter (OD)] or less be contained in a rigid metal pipe.

302.14.3 Piping in concrete floors. Piping installed in concrete floors shall be encased in pipe duct. Where piping passes through concrete or masonry walls, ceilings, floors or beams, such piping shall be provided with metal sleeves or thimbles that shall be a minimum of ⅜ inch larger than the outside diameter of the piping, in addition to the insulation. All voids between piping and casing shall be adequately enclosed with an approved material.

SECTION 303 NFPA 96

303.1 General. Commercial kitchen ventilation hoods, ducts and exhaust equipment shall comply with NFPA 96 and this Code. Where conflicts between NFPA 96 and this Code exist, the most stringent standard shall be applied as determined by the Building Official.

SECTION 304 CLEARANCES TO COMBUSTIBLE MATERIALS

304.1 Special fuel-burning equipment. See Chapter 9 for clearances to combustible materials for special fuel-burning equipment.

304.2 Combustible floors. Heat-producing appliances listed for mounting on combustible floors shall be installed in strict accordance to their listings, subject to the approval of the Chief Mechanical Inspector.

304.3 Walls and ceilings.

304.3.1 Clearances for listed appliances. Clearances for listed heat-producing appliances and their accessories, when listed for greater or less clearances than stipulated in this Code, shall conform to their listings, subject to the approval of the Chief Mechanical Inspector.

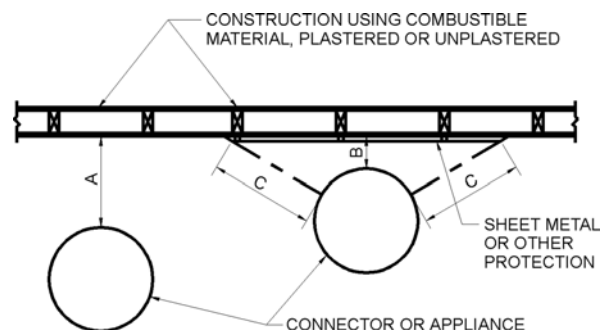
304.3.2 Clearances not specified. Clearances not covered in this Code shall be subject to the approval of the Chief Mechanical Inspector.

304.3.3 Conflicts with Table 304. Clearances covered in this Code shall conform to Table 304, except if the clearances shown in the various Sections of this Code differ, they shall take precedence over those shown in Table 304, subject to the approval of the Chief Mechanical Inspector.

SECTION 305 CLEARANCES WITH PROTECTION

305.1 Reduced clearance locations. Appliances shall be installed in rooms, but not in alcoves or closets, with clearances less than specified in Table 304, provided the combustible material or appliance is protected as described in Table 305.

Exception: Clearances established by listing agency.



**FIGURE 305
REDUCED CLEARANCE DIAGRAM**

Note: "A" equals the required clearance with no protection, specified in Table 304. "B" equals the reduced clearance permitted in accordance with Table 305. The protection applied to the construction using combustible material shall extend far enough in each direction to make "C" equal to "A."

305.2 Air circulation.

305.2.1 Adequate circulation. Adequate air circulation shall be provided by having all edges of the wall protector open a minimum of 1 inch.

GENERAL REQUIREMENTS

TABLE 304

STANDARD INSTALLATION CLEARANCES FOR HEAT-PRODUCING APPLIANCES^a (inches)

These clearances apply unless otherwise shown on listed appliances. Appliances shall not be installed in alcoves or closets unless approved for such installation. For installation on combustible floors, see Note b.

APPLIANCE		CLEARANCES					
Residential-type appliance for installation in rooms that are large ^c		Above top of casing or appliance	From top and sides of warm-air bonnet or plenum	From front ^d	From back	From sides	
Boilers and water heaters Steam boilers 15 psi Water boilers 250°F Water heaters 250°F All water walled or jacketed	Automatic oil or Combination gas-oil	6	—	24	6	6	
	Automatic gas	6	—	18	6	6	
	Solid	6	—	48	6	6	
	Electric	6	—	18	6	6	
Clothes dryers Listed types	Gas	6	—	24	6	6	
	Electric	—	—	—	—	—	
Furnaces, central Gravity, upflow, downflow, horizontal and duct Warm-air 250°F maximum	Automatic oil or Combination gas-oil	6 ^e	6 ^e	24	6	6	
	Automatic gas	6 ^e	6 ^e	18	18	18	
	Solid	18 ^f	18 ^f	48	18	18	
	Electric	6 ^e	6 ^e	18	6	6	
Furnaces, floor For mounting in combustible floors	Automatic oil or Combination gas-oil	36	—	12	12	12	
	Automatic gas	36	—	12	12	12	
Heat exchanger Steam 15 psi maximum Hot water 250°F maximum	—	1	1	1	1	1	
	—	1	1	1	1	1	
Incinerators Domestic types	—	See Note j 36	—	48	36	36	
Radiators Steam or hot water	Gas	See Note g 36	—	6	6	6	
Ranges, cooking stoves Vented or unvented	Oil	30	—	—	9	Firing side 24	Opp. side 18
	Gas	30	—	—	6	6	6
	Solid—clay- lined firepot	30	—	—	24	24	18
	Solid—unlined firepot	30	—	—	36	36	18
	Electric	30	—	—	6	6	—

(continued)

TABLE 304—continued

STANDARD INSTALLATION CLEARANCES FOR HEAT-PRODUCING APPLIANCES^a (inches)

These clearances apply unless otherwise shown on listed appliances. Appliances shall not be installed in alcoves or closets unless approved for such installation. For installation on combustible floors, see Note b.

APPLIANCE		CLEARANCES				
Residential-type appliance for installation in rooms that are large ^c		Above top of casing or appliance	From top and sides of warm-air bonnet or plenum	From front ^d	From back	From sides
Room heaters Circulating-type— vented or unvented Radiant or other type— vented or unvented	Oil or solid	36	—	24	12	12
	Gas	36	—	24	12	12
	Oil or solid	36	—	36	36	36
	Gas	36	—	36	18	18
	Gas with double metal or ceramic back	36	—	36	12	18
APPLIANCE		CLEARANCES				
Commercial-industrial-type, low-heat appliances any and all physical sizes, except as noted		Above top of casing or appliance ⁱ	From top and sides of warm-air bonnet or plenum	From front	From back ^h	From sides ^h
Boilers and water heaters 100 cubic feet or less— any psi steam 50 psi or less— any size	All fuels ^{a, h}	—	48	18	18	—
	All fuels ^{a, h}	—	48	18	18	—
Infrared heaters		18	—	60	18	18
Other low-heat industrial appliances Floor mounted or suspended	All fuels ^{a, h}	18	48	18	18	—
Ranges, restaurant type Floor mounted	All fuels ^{d, h}	—	48	18	18	—
Unit heaters Floor mounted or suspended—any size Suspended—100 cubic feet or less Suspended—100 cubic feet or less Floor mounted—any size	Steam or hot water	1	—	1	1	—
	Oil or combination gas-oil	6	—	24	18	18
	Gas	6	—	18	18	18
	All fuels ^{a, h}	—	48	18	18	—

(continued)

GENERAL REQUIREMENTS

TABLE 304—continued

STANDARD INSTALLATION CLEARANCES FOR HEAT-PRODUCING APPLIANCES^a (inches)

These clearances apply unless otherwise shown on listed appliances. Appliances shall not be installed in alcoves or closets unless approved for such installation. For installation on combustible floors, see Note b.

APPLIANCE		CLEARANCES				
Commercial-industrial-type, medium-heat appliances any and all physical sizes, except as noted		Above top of casing or appliance ⁱ	From top and sides of warm-air bonnet or plenum	From front	From back ⁱ	From sides ⁱ
Boilers and water heaters Over 50 psi Over 100 cubic feet	All fuels ^{d, h}	—	96	36	36	—
Incinerators All sizes		48	—	96	36	36
Other medium-heat industrial appliances All sizes	All fuels ^{d, h}	36	96	36	36	—
APPLIANCE		CLEARANCES				
Industrial-type, high-heat appliances		Above top of casing or appliance ⁱ	From top and sides of warm-air bonnet or plenum	From front	From back ⁱ	From sides ⁱ
High-heat industrial appliances All sizes	All fuels ^{a, h}	—	360	120	120	—

- Standard clearances shall be reduced by providing protection to combustible material in accordance with Table 305.
- An appliance shall be installed on a combustible floor when conforming to Subsection 304.2.
- Rooms that are large in comparison to the size of the appliance are those having a volume equal to not less than 12 times the total volume of a furnace and not less than 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 feet, the volume of a room shall be computed on the basis of a ceiling height of 8 feet.
- The minimum dimension shall be that required for servicing the appliance, including access for cleaning and normal care, tube removal, etc.
- For a listed oil, combination gas-oil, gas or electric furnace, this dimension shall be 2 inches if the furnace limit control cannot be set higher than 250°F, or this dimension may be 1 inch if the limit control cannot be set higher than 200°F.
- The dimension may be 6 inches for an automatic stoker-fired, forced warm-air furnace equipped with 250°F limit control and with barometric draft control operated by draft intensity and permanently set to limit draft to a maximum intensity of 0.13 inch water gage.
- If the underside of a combustible material or metal cabinet is protected with mineral wool bats (blanket or board) that have a minimum density of 8 pounds per cubic foot and have a minimum melting point of 1,500°F, the distances shall be reduced to not less than 24 inches. Insulation material utilized as part of a clearance reduction system shall have a thermal conductivity of 1.0 (Btu · in)/(ft² · h · °F) or less.
- If the appliance is encased in brick, the 18-inch clearance above, and at the sides and rear, shall be reduced to not less than 12 inches.
- If the appliance is encased in brick, the clearance above shall be not less than 36 inches, and at the sides and rear shall be not less than 18 inches.
- Clearance above the charging door shall be not less than 48 inches.

305.2.2 Single flat wall. If the wall protector is mounted on a single flat wall away from corners, adequate air circulation shall be provided by having only the bottom and top edges, or the side and top edges, open a minimum of 1 inch.

305.2.3 Two walls. Wall protectors covering two walls in a corner shall be open at the bottom and top edges a minimum of 1 inch.

305.3 Clearance measurement. All clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the solid fuel-burning appliance.

305.4 Chimney connectors. All clearances provided between solid fuel-burning appliances and combustible materials shall be large enough to maintain sufficient clearances between the combustible material and chimney connectors.

TABLE 305^{a, c, d, f, g, h, i}
CLEARANCES WITH SPECIFIED FORMS OF PROTECTION
(inches)

TYPE OF PROTECTION APPLIED TO THE COMBUSTIBLE MATERIAL UNLESS OTHERWISE SPECIFIED AND COVERING ALL SURFACES WITHIN THE DISTANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION THICKNESSES ARE MINIMUM (see Figure 305)	MAXIMUM ALLOWABLE REDUCTION IN CLEARANCE (percent)		WHERE REQUIRED CLEARANCE WITH NO PROTECTION IS (inches)							
			36		18		12		6	
	Wall	Ceiling	Wall	Ceiling	Wall	Ceiling	Wall	Ceiling	Wall	Ceiling
3 1/2-inch-thick masonry wall with no airspace ^e	33	—	24	—	12	—	8	—	4	—
1/2-inch noncombustible insulation board over 1-inch glass fiber or mineral wool batts with no airspace	50	33	18	24	9	12	6	8	3	4
Sheet metal, 0.0239 inch (24 gage), over 1-inch glass fiber or mineral wool batts reinforced with wire on rear face with ventilated airspace ^b	66	50	12	18	6	9	4	6	2	3
3 1/2-inch masonry wall with ventilated airspace ^{b, c}	66	—	12	—	6	—	4	—	2	—
Sheet metal, 0.0239 inch (24 gage), with ventilated airspace ^b	66	50	12	18	6	9	4	6	2	3
1/2-inch-thick, noncombustible insulation board with ventilated airspace ^b	66	50	12	18	6	9	4	6	2	3
1-inch glass fiber or mineral wool batts, sandwiched between two sheets of sheet metal, 0.0239 inch (24 gage), with ventilated airspace ^b	66	50	12	18	6	9	4	6	2	3

- Spacers and ties shall be noncombustible. They shall not be used directly behind an appliance or a connector.
- With all clearance reduction systems using ventilated airspace, adequate air circulation shall be provided as described in Subsections 305.1 through 305.4. There shall be a minimum of 1 inch between the clearance reduction system, and combustible walls and ceilings.
- Mineral wool batts shall have a minimum density of 8 pounds per cubic foot and have a minimum melting point of 1,500°F.
- Insulation material shall have a thermal conductivity of 1.0 (Btu · in)/(ft² · h · °F) or less.
- If a single wall connector passes through the masonry wall, there shall be a minimum of 1/2 inch of open ventilated airspace between the connector and the masonry.
- There shall be a minimum of 1 inch between the appliance and protector. The clearance between the appliance and the wall surface shall not be reduced below that allowed in this Table.
- Clearances in front of the loading door and/or ash removal door of the appliance shall not be reduced from those required in Table 304.
- All clearances and thicknesses are minimums; larger clearances and thicknesses are acceptable.
- To calculate the minimum allowable clearance, the following formula may be used: $C_{PR} = C_{UN} \times (1 - R/100)$; C_{PR} is the minimum allowable clearance; C_{UN} is the required clearance with no protection; R is the maximum allowable reduction in clearance.

SECTION 306 TESTS AND INSPECTIONS

306.1 General. Work shall not be concealed prior to inspection and tests.

306.2 Boilers. Boiler controls shall be tested in accordance with Section 1005.

306.3 Liquefied petroleum gas piping. Liquefied petroleum gas (LP-gas) piping shall be tested in accordance with Section 1303.

306.4 Machinery room ventilation system. The machinery room ventilation system shall be tested in accordance with Subsection 1104.4.

306.5 Masonry chimneys. Masonry chimneys shall be tested in accordance with Subsection 804.6.

306.6 Natural gas piping. Natural gas piping shall be tested in accordance with Section 1302.

306.7 Panel heating system piping. Panel heating system piping shall be tested in accordance with Subsection 1202.4.

306.8 Piping. All pipe, except cast iron and plastic as approved in this Code, shall be tested with nitrogen, compressed air or other inert gas (not oxygen); or hydrostatically at a minimum of $1\frac{1}{2}$ times the operating pressure. Cast-iron pipe shall be tested hydrostatically, only. Approved plastic piping shall be tested at $1\frac{1}{2}$ times the operating pressure of the system. Hydraulic piping and pumping equipment shall be tested at $1\frac{1}{2}$ times the maximum rated pressure capabilities of the pump. If a pressure-limiting device is used with pump shutdown controls, the pressure test shall be reduced to $1\frac{1}{2}$ times the maximum operating pressure.

306.9 Refrigerant.

306.9.1 Piping. Refrigerant piping shall be tested in accordance with Section 1106.

306.9.2 System components. Refrigerant containing components of systems shall be tested in accordance with Section 1107.

306.10 Thermal storage systems.

306.10.1 Tanks. Pressurized tanks shall be tested in accordance with Section 1508.

306.10.2 Piping. Piping shall be tested in accordance with Subsection 1511.10.

SECTION 307 PIPING INSULATION

307.1 General.

307.1.1 Suitability. All coverings or insulation used in heating and cooling systems shall be of materials suitable for the operating temperature of the system. The insulation, jackets and lap-seal adhesives shall be tested as a composite product, and shall have a flame spread rating of not more than 25 and a smoke-developed rating of not more than 450 when tested in accordance with ASTM E84.

307.1.2 Plenum installations. Pipe insulation and coverings used in plenum chambers shall have a flame spread rating of not more than 25 and a smoke-developed rating of not more than 50 when tested in accordance with ASTM E84.

307.1.3 Damage protection. Insulation on equipment and components in areas where it is subject to physical damage shall be covered with a minimum of 0.032-inch aluminum or its equivalent. Insulation in mechanical equipment rooms shall be covered with a minimum of 0.020-inch aluminum.

307.1.4 Integrity. Insulation shall be sized properly throughout the system and shall be of the same type and density. Insulation materials shall not be mismatched or intermingled.

Exception: Elastomeric insulation shall be used in conjunction with foam glass insulation, provided the foam glass is coated with an approved mastic, 6 inches on the ends that fill the cells of the foam glass completely and must cure prior to joining the elastomeric insulation to the foam glass insulation with contact cement. Lap seals shall be a minimum of 4 inches on each side of the joint connected and the head or butt-end joint.

307.1.5 Sealing. Insulation on pipe, equipment and components shall be sealed with an approved vapor-tight sealer.

307.1.6 Form fitting. Pipe insulation fittings shall be form fitted. Insulation on 90-degree elbows less than 1 inch shall be preformed type. Insulation on 90-degree elbows 1 inch and greater shall not be one piece mitered.

307.1.7 Limited absorption. Insulation that is fibrous or absorbent shall not be used on piping systems that have the potential to condensate or receive moisture intrusion from any source.

307.2 Piping insulation thermal performance.

307.2.1 Insulation required. Piping installed to service buildings and within buildings shall be thermally insulated in accordance with Table 307.

Exception: Piping insulation is not required in the following cases:

1. Piping installed within HVAC equipment.
2. Piping at fluid temperatures between 55°F and 120°F when not required for energy conservation purposes.
3. When the heat loss and/or heat gain of the piping without insulation does not increase the energy requirement of the building.
4. When piping is installed in basements, cellars or unventilated crawl spaces having insulated walls in one- and two-family dwellings.

307.2.2 Thermal resistivity. Insulation thicknesses in Table 307 are based on insulation having thermal resistivity in the range of 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having values less than 4.0 per inch of thickness, or shall be reduced for mate-

rials having values greater than 4.6 per inch of thickness as follows:

- (a) For materials with thermal resistivity greater than 4.6 per inch of thickness, the minimum insulation thickness shall be increased as follows:

$$\frac{4.6 \times \text{Table 307 Thickness}}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

- (b) For materials with thermal resistivity less than 4.0 per inch of thickness, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 307 Thickness}}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

307.2.3 Protection from steam or hot water. In locations where steam or hot water piping may be contacted by personnel, sufficient insulation shall be installed to maintain a surface temperature not exceeding 130°F based on operating temperatures and ambient air conditions.

307.2.4 Condensation. Chilled condenser water, condensate and refrigeration piping containing liquids or gases, which would result in the formation of condensation if exposed, shall be suitably insulated to prevent such condensation.

SECTION 308 ELECTRICAL CONNECTIONS

308.1 General. All electrical connections between fuel-fired appliances, mechanical equipment, etc., and the building wiring shall conform to NFPA 70.

308.2 Disconnects and receptacles. A 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed at a readily accessible location for the servicing of heating, air-conditioning and refrigeration equipment. The disconnecting means for heating, air-conditioning and refrigeration equipment shall in no case be installed farther than 6 feet from the service side of the equipment.

308.3 Ignition and control devices. Devices employing or depending upon an electrical current shall not be used to control or ignite a fuel supply, if of such a character that failure of the electrical current could result in the escape of unburned fuel or in the failure to reduce the supply of fuel under conditions that would normally result in its reduction, unless other means are provided to prevent the development of dangerous temperatures, pressures or the escape of fuel.

308.4 Electrical ground. The fuel piping system shall not be used as a grounding electrode for an electric fuse panel, telephone circuit or lightning arrestor. Electric circuits shall not utilize fuel piping, casing of controls, panels or other metal parts in lieu of an electrical conductor. This provision shall not apply to low-voltage control and ignition circuits, nor to electronic flame detection device circuits incorporated as part of the appliance.

308.5 Electrical circuit. The electrical circuit employed for operating the automatic main fuel control valve, safety shutoff device, room temperature thermostat, limit control or other electrical devices used with a fuel-burning appliance shall be in accordance with the wiring diagrams supplied with the appliance.

308.6 Continuous power. All fuel-burning appliances using electrical controls shall have the controls connected into a permanently live electrical circuit, i.e., one that is not controlled by a light switch.

SECTION 309 APPENDIX REFERENCES

309.1 Heat loss and heat gain. Additional provisions for estimating heat loss and heat gain are contained in Appendix A. These provisions are applicable only where specifically included in the adopting ordinance.

309.2 Thermal resistance. Additional provisions for determining thermal resistance (*R*) values for air-distribution ducts and plenums are contained in Appendix B. These provisions are applicable only where specifically included in the adopting ordinance.

TABLE 307
MINIMUM PIPE INSULATION THICKNESS (inches)

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGE, °F	PIPE SIZES ^b (nominal diameter)				
		Runouts 2 inches ^a	1 inch and less	1 ¹ / ₄ to 2 inches	2 ¹ / ₂ to 4 inches	5 inches and larger
Heating systems						
Steam and hot water						
High pressure/temperature	306 – 450	1 ¹ / ₂	2 ¹ / ₂	2 ¹ / ₂	3	3 ¹ / ₂
Medium pressure/temperature	251 – 305	1 ¹ / ₂	2	2 ¹ / ₂	2 ¹ / ₂	3
Low pressure/temperature	201 – 250	1	1 ¹ / ₂	1 ¹ / ₂	2	2
Low temperature	120 – 200	1 ¹ / ₂	1	1	1 ¹ / ₂	1 ¹ / ₂
Steam condensate (for feed water)	Any	1	1	1 ¹ / ₂	2	2
Cooling systems						
Chilled water, refrigerant or brine	40 – 55 Below 40	1 ¹ / ₂ 1	1 ¹ / ₂ 1	3 ⁴ / ₄ 1 ¹ / ₂	1 1 ¹ / ₂	1 1 ¹ / ₂

a. Runouts not exceeding 12 feet in length to individual terminal units.

b. For piping exposed to outdoor air, increase thickness by 1¹/₂ inch.

CHAPTER 4

VENTILATION AIR SUPPLY

SECTION 401 GENERAL

401.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of ventilation air supply systems.

401.2 Rooms containing flammable, combustible or noxious gases. A separate and individual ventilation system, which is not part of any other system, shall be provided for the ventilation of each room or space containing flammable vapors, combustible vapors, noxious gases and flammable dusts, or where serving incompatible materials.

401.3 Commercial cooking equipment. For commercial food heat-processing equipment exhaust systems, see Sections 503 and 504.

401.4 Vestibule ventilation. Vestibule ventilation for smoke-proof enclosures shall be in accordance with the *EPCOT Building Code*.

401.5 Installation. The requirements of Chapter 3 shall apply to ventilation equipment.

401.6 Ducts. Ducts and plenums used in a ventilation system shall be constructed of approved materials, braced, supported, joined, assembled and sealed as required in Chapter 6.

SECTION 402 REQUIRED SYSTEMS AND VENTILATION RATES

402.1 Ventilation requirements. Each building or portion thereof shall be provided with the capability to provide ventilation in accordance with ASHRAE 62.1.

SECTION 403 MOTORS, FANS AND FILTERS

403.1 General. Motors and fans shall be of sufficient capacity to provide the required air movement as specified in the *EPCOT Building Code*. Every motor and fan shall be so installed as to afford access for servicing or maintenance. Exposed openings in fan housings shall be protected with screens or gratings of not greater than 1/2-inch mesh to prevent accidents or the entry of foreign material.

403.2 Motors. Fan motors, except National Electrical Manufacturers Association (NEMA) Class I explosionproof motors, shall not be installed inside ducts or under hoods in any ventilation system conveying flammable vapors or combustible dusts, nor shall any belt- or chain-driven apparatus be inside any such duct or under any such hood, unless the belt or chain, and any pulley connection therewith, is entirely enclosed and grounded, except motors and receptacles listed for the class, group and division of flammable vapors or combustible dusts as indicated in Article 500 of NFPA 70.

403.3 Blades.

403.3.1 Blade construction. Every fan blade located in any duct shall be of rigid, noncombustible construction. In any ventilation system conveying flammable vapors or combustible dust, the fan blade, shaft and casing shall be of a non-sparking material. Bearings for fans shall be self-lubricating or shall be lubricated from outside the duct.

403.3.2 Blade protection. Rotary fans without fan-blade protection shall provide for not less than 8 feet of clearance from the finished floor level to the bottom side of the unprotected fan blades.

Exception: Fan blades of low-speed, residential-type ceiling fans installed within dwelling units shall be located a minimum of 6 feet, 8 inches from the finished floor.

403.4 Air filters. Air filters, other than grease hood filters regulated by Chapter 5, shall be of a type that, in a clean state, will not burn freely. Liquid adhesive coatings used on filters shall have a flash point of 325°F, Cleveland open cup tester, or higher. Filters qualifying as Class 1 or 2 shall be accepted as meeting these requirements. Evaporative coolers containing a combustible evaporation medium, such as excelsior, shall not be used.

SECTION 404 FRESH AIR INTAKES

404.1 Intake opening location. Air intake openings shall comply with all of the following:

1. Intake openings shall be located a minimum of 10 feet from lot lines or buildings on the same lot.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks that accommodate vehicular traffic, except as specified in Item 3. Outdoor air intake openings shall be permitted to be located less than 10 feet horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet below contaminant sources where such sources are located within 10 feet of the opening.

404.2 Air intake protection. Outdoor air intakes shall be protected against fire exposure by means of approved fire doors, dampers or other suitable protection in accordance with the degree of exposure hazard, and shall be screened with a corrosion-resistant material not greater than 1/2-inch mesh.

SECTION 405 FAN SHUTDOWN CONTROLS

405.1 Where required. Smoke detectors listed for use in air distribution systems shall be located as follows:

- (a) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 2,000 cfm.
- (b) At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 15,000 cfm and serving more than one story.
- (c) All air distribution systems serving a means of egress shall be provided with a duct smoke detector and automatic shutdown.

405.1.1 Area smoke detectors. Return system smoke detectors shall not be required where the entire space served by the air distribution system is protected by a system of area smoke detectors installed in accordance with NFPA 72.

405.1.2 Exhaust. Smoke detectors shall not be required for fan units whose sole function is to remove air from the inside of the building to the outside of the building.

405.2 Function.

405.2.1 Automatic stop. Smoke detectors required by Subsection 405.1 shall automatically stop their respective fan(s) on detecting the presence of smoke.

Exception: Where the return air fan is functioning as part of an engineered smoke-control system and a different mode is required, the smoke detectors shall not be required to automatically stop their respective fans.

405.3 Supervision. The duct smoke detectors shall be connected to a fire alarm system where a fire alarm system is required by the *EPCOT Building Code* and the *EPCOT Fire Prevention Code*. The actuation of a duct smoke detector shall activate a visible and audible supervisory signal at a constantly attended location.

Exceptions:

1. The supervisory signal at a constantly attended location shall not be required where the duct smoke detector activates the building's fire alarm system.
2. In occupancies not required to be equipped with a fire alarm system, actuation of a smoke detector shall activate a visible and audible signal in an approved location. Duct smoke detector trouble conditions shall activate a visible or audible signal in an approved location and shall be identified as air duct detector trouble.

405.4 Fire sprinkler interlock required. In buildings or structures provided with an automatic fire sprinkler system, air distribution systems with a capacity greater than 2,000 cfm shall shutdown upon the activation of the automatic fire sprinkler water flow alarm.

405.4.1 Means of egress. All air distribution systems serving a means of egress in buildings or structures with

automatic fire sprinkler systems shall shutdown upon activation of the automatic fire sprinkler water flow alarm.

405.5 Controls. All controls shall be listed.

405.6 Manual reset. Air distribution systems required to shut down by this Section shall not restart until manually reset.

SECTION 406 ACCESS CORRIDORS

406.1 Return air plenums. It shall be prohibited to use exit access corridors for return or exhaust from adjoining air-conditioned spaces through louvers or other devices mounted in corridor doors, partitions or ceilings.

406.2 Fan shut down by smoke detectors. Except in Group I or R occupancies, Subsection 406.1 may be waived by the Chief Mechanical Inspector, provided corridors are equipped with approved smoke detectors arranged to automatically stop supply, return and exhaust, and close louvers or other devices mounted within the corridor doors, partitions or ceilings.

SECTION 407 STAIRWELL ENCLOSURES

407.1 Ducts serving other spaces. Ducts serving other spaces shall not be located in or pass through exit enclosures.

407.2 Smokeproof enclosures. Where required for high-rise buildings, stairwells shall be designed as smokeproof enclosures in accordance with *EPCOT Building Code* Subsection 720.20.

SECTION 408 RETURN AIR INTAKE

408.1 Separation requirements. The return air intake for a recirculating air-conditioning system shall not be closer than 10 feet from a cooking appliance.

Exception: Microwave ovens.

SECTION 409 ENCLOSED PARKING GARAGES

409.1 Enclosed parking garages. Mechanical ventilation systems for enclosed parking garages are not required to operate continuously where the system is arranged to operate automatically upon detection of a concentration of carbon monoxide of 25 parts per million by approved automatic detection devices.

409.2 Minimum ventilation. Automatic operation of the system shall not reduce the ventilation rate to be less than 5 cfm per person, and the system shall be capable of producing a ventilation rate of 1½ cfm per square foot of floor area.

409.3 Occupied spaces accessory to public garages. Connecting offices, waiting rooms, ticket booths and similar uses that are accessory to a public garage shall be maintained at a positive pressure and shall be provided with ventilation in accordance with Section 402.

CHAPTER 5

EXHAUST SYSTEMS

SECTION 501 GENERAL

501.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of exhaust systems.

501.2 Pressure equalization. If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust system for a room, adequate means shall be provided for the natural exit of the excess air supplied. If only a mechanical exhaust system is installed for a room, or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate means shall be provided for the natural supply of the deficiency in the air supplied.

501.3 Outdoor discharge. The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a nuisance and from which it cannot again be readily drawn in by a ventilating system. Exhausting air into an attic or crawl space shall be prohibited. Air that is to be used for recirculation shall be discharged to a supply system.

Exception: Attic fans may be permitted to discharge into the attic space of residences having private attics.

501.4 Independent system required. Mechanical exhaust from bath, toilet, urinal, locker, service sink, closets and similar rooms shall be an independent system and shall not be recirculated, unless treated by a listed or approved air-treatment system. When exhaust systems are used, they shall be combined with similar exhaust, except kitchen exhaust shall be on an independent system.

501.5 Ducts. The materials used in every mechanical exhaust system shall be of sheet metal or other approved materials in accordance with Chapter 6.

SECTION 502 REQUIRED SYSTEMS

502.1 General. An exhaust system shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders, and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air; or that emit heat, odors, fumes, spray, gas or smoke in such quantities as to be irritating or injurious to health or safety, and shall mechanically discharge such exhaust to the outdoor atmosphere. The total outdoor air supplied shall be equal in volume to that removed.

502.2 Equipment and service rooms. All equipment and system service rooms, which house sources of odors, fumes, noxious gases, smoke, steam, dust, spray or other contamina-

tion, shall be such as to prevent the spreading of any such contamination to any other occupied parts of the building.

502.3 Lavatories, toilets, bathrooms and restrooms.

502.3.1 Recirculation prohibited. Air exhausted from bath, toilet, urinal, lavatory, locker, coat room or similar rooms shall not be recirculated. Air within a room that contains a bathtub and/or shower shall be mechanically exhausted to the outdoors, or shall have windows as specified for habitable rooms providing in no case less than 3 square feet of open space.

502.3.2 Mechanical exhaust. Where natural ventilation or an approved air-treatment system is not provided, 2 cubic feet of air per minute per square foot of floor area shall be exhausted from lavatories, toilets, bathrooms and restrooms.

Exceptions:

1. For lavatories, toilets, bathrooms and restrooms in one- and two-family dwellings, exhaust air may be reduced to a minimum of 1 cubic foot per minute (cfm) per square foot of floor area.
2. For private toilet rooms with not more than one water closet and one lavatory, exhaust air shall be reduced to a minimum of 1 cfm per square foot of floor area.

SECTION 503 COMMERCIAL HOODS

503.1 General. An exhaust hood shall be installed for all commercial, industrial, institutional and other food heat-processing equipment producing smoke or grease-laden air.

Exceptions:

1. Domestic equipment installed within a dwelling unit.
2. Cabinet-type ovens that do not heat the food product core to a temperature greater than 212°F.

503.2 Minimum volume of exhaust. The hood shall be designed with a sufficient air volume to properly exhaust all grease and smoke vapor produced by the equipment that it serves. Unless the hood is designed and certified by a licensed architect or professional engineer, or is an approved prefabricated hood tested and certified by the manufacturer, the following requirements shall be met:

- (a) Canopy-type hoods shall be a minimum of 2 feet deep from the bottom edge to the top edge of the hood and shall overhang the equipment they serve a minimum of 6 inches on all open sides.
- (b) The bottom edge of a canopy-type hood shall be a maximum of 7 feet above the floor.

EXHAUST SYSTEMS

- (c) Canopy hoods that open on all sides shall have a minimum exhaust capacity of 150 cfm per square foot of hood area.
- (d) Canopy-type hoods that open on three or less sides shall have a minimum exhaust capacity of 100 cfm per square foot of hood area.
- (e) Backshelf-type hoods having an intake within 3 feet of vapor-producing surfaces shall have a minimum exhaust capacity of 300 cfm per linear foot of cooking surface within a maximum distance of 1 foot from the face of the hood to the front edge of the equipment they are serving.
- (f) Provisions shall be made to admit air to the room where the hood is located at a rate not less than that which is exhausted by the hood.

503.3 Construction and installation. All hoods shall be constructed and installed in accordance with the following:

- (a) Hoods shall be constructed of and supported by steel of 0.0478-inch-minimum thickness or stainless steel of 0.0359-inch-minimum thickness, or of other material of equivalent strength, fire and corrosion resistance as approved by the Chief Mechanical Inspector.
- (b) Hoods shall be securely supported by noncombustible supports. All commercially manufactured hood hanger provisions shall be used in supporting the hood. Angle iron, when required, shall be a minimum of 3 inches by 3 inches by $\frac{1}{4}$ inch. Thread rods, when used, shall be $\frac{1}{2}$ -inch minimum. Hanger rods shall not be bent or formed.
- (c) All seams and joints, and penetrations of the hood enclosure that direct and capture grease-laden vapors and exhaust gases, shall have a liquid-tight external weld to the lower outermost perimeter of the hood. Internal hood joints, seams, filter support frames and appendages attached inside the hood need not be welded but shall be sealed or otherwise made grease tight.
- (d) Hoods shall be so designed and installed to provide for thorough cleaning of the entire hood.
- (e) When grease troughs or gutters are provided, they shall drain to a collecting receptacle designed, fabricated and installed to be readily accessible for cleaning.

503.4 Clearance. Every portion of the hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches, provided the combustible material is protected with materials as approved for 1-hour fire resistance on the hood side.

503.5 Grease removal devices. Each hood shall be equipped with a properly sized grease removal device of one of the following types:

- (a) Grease extractors specifically listed for this service and installed in accordance with the terms of its listing.
- (b) Grease filters or other grease removal devices specifically listed for use with commercial cooking equipment installed with the height of the lowest edge of the grease filter or other removal device located above the

cooking or heating surface not less than the distances shown in Table 503.5.

TABLE 503.5
MINIMUM DISTANCE BETWEEN LOWEST EDGE OF
GREASE FILTER AND COOKING OR HEATING SURFACE

	DUCT SYSTEM AND HOOD WITH FIRE-EXTINGUISHING SYSTEM ^a (feet)
No exposed flame: grills, french fryers, etc.	1½
Exposed flame and burners	2
Exposed charcoal and charcoal type fires	4

a. Fire-extinguishing system shall be of an approved type.

503.6 Grease filters. Filters shall be tight fitting and firmly held in place, yet easily accessible and removable without special tools. They shall be installed at a minimum angle of 45 degrees from the horizontal. A drip tray designed and located to collect the grease from the filters and drain to an enclosed noncombustible container shall be provided beneath the lower edge of the filters. The container shall have a maximum capacity of 1 gallon, unless otherwise approved by the Chief Mechanical Inspector.

SECTION 504

GREASE HOOD DUCT SYSTEMS

504.1 Construction. Duct systems serving exhaust hoods that remove smoke and grease-laden vapors shall be constructed of and supported by steel of 0.0598-inch-minimum thickness or stainless steel of 0.0478-inch-minimum thickness, or of other material of equivalent strength, fire and corrosion resistance as approved by the Chief Mechanical Inspector. Ducts constructed of materials that are subject to corrosion shall be suitably protected when installed outdoors.

504.1.1 Grease-laden vapors. Exhaust hoods and duct work serving exhaust hoods for removing grease-laden vapors shall be constructed of noncorrosive material. Black iron is prohibited for use in grease-laden vapor removal systems.

504.2 Seams and joints. All seams and joints shall be made liquid tight with a continuous external weld. All seams and joints shall be made by a certified welder. Certification shall be in accordance with ANSI/AWS D9.1. Test coupons shall be of the same base metals that will be installed in the exhaust system (stainless, galvanized, etc.). Coupon thickness shall not exceed 0.078 inch or 14 gage. The welding process in which the welder certifies [gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and/or shielded metal arc welding (SMAW)] limits the welder to only that process.

Recertification shall be required in the event the welder has a one-year absence from welding within the jurisdiction of the District.

All welder certification and welding documentation shall be supplied to the Department of Building and Safety at the time the permit application is made.

504.3 Listing. All duct systems furnished as a part of a grease extractor listed by a nationally recognized testing agency are considered to comply with these requirements when installed in accordance with the terms of their listing.

504.4 Minimum slope. All sections of the duct system shall be constructed and installed without forming dips and traps, and shall slope not less than 1 inch per foot toward either the hood or an approved residue trap.

504.4.1 Solid fuel-grease duct systems. Solid fuel-grease duct systems shall be constructed and installed without dips or traps with a slope not less than 12 inches per foot (less than 45 degrees) toward the hood. Solid fuel-grease duct systems shall maintain the shortest distance vertically to the exterior of the building or structure.

504.5 Openings.

504.5.1 Opening limitations. The duct system shall have only those openings required for the proper operation and maintenance of the system. For cleaning purposes, cleanout openings shall be provided at each change in direction of the duct and at any other portion of the system not accessible from the duct inlet or discharge. All cleanout openings shall be located on the sides of the duct and shall be of sufficient size to permit a thorough cleaning of the entire system. Access panels shall be of the same materials and thickness as the duct. Access panels shall have a gasket that is rated for 1,500°F and shall be grease tight. Fasteners used to secure the access panels, such as bolts, welded studs, latches or wing nuts, shall be of galvanized carbon steel or stainless steel, and shall not penetrate the duct wall. Doors or covers shall be so designed that they can be opened or removed without the use of a tool.

Exception: Listed grease duct door assemblies shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.

504.5.2 Required signage. A sign shall be placed on all access panels stating: "ACCESS PANEL—DO NOT OBSTRUCT."

504.5.3 Access to dampers. For listed hoods with dampers in the exhaust collar, an access panel for cleaning and inspection shall be provided in the duct or hood collar and within 18 inches of the hood.

504.5.4 Access to fans. Exhaust fans with ductwork connected to both sides of the fan shall have access for inspection and cleaning within 3 feet on each side of the fan.

504.5.5 Personnel access. On horizontal ducts, a minimum of one, 20-inch by 20-inch opening shall be provided for personnel entry. Horizontal ducts shall be secured sufficiently to allow for the weight of personnel entry into the duct. Where an opening of this size is not possible, openings large enough to permit thorough cleaning shall be provided at 12-foot intervals.

504.5.6 Opening location. In horizontal sections, the lower edge of the opening shall be not less than 1½ inches from the edge of the duct.

504.5.7 Vertical ductwork. On vertical ductwork where personnel entry is possible, access shall be provided at the

top of the vertical riser to accommodate descent. Where personnel entry is not possible, adequate access shall be provided on each floor.

504.6 Support. Duct systems shall be properly supported and securely fastened in place at every change in direction and as required in Chapter 6. Supports or fasteners shall not penetrate any duct or plenum.

504.7 Minimum velocity. Duct systems shall be designed and installed in a manner that provides an air velocity within the duct system of not less than 1,500 feet per minute.

Exception: Net exhaust volumes for new and existing installations may be reduced to a minimum of 500 feet per minute during part-load cooking conditions, where engineered or listed, multispeed or variable-speed controls automatically operate the exhaust system to maintain capture and removal of cooking effluents as required by this Section. For new installations, the duct shall be insulated in its entirety to an *R*-value not less than *R*-10. Insulation materials shall be suitable for use with a grease duct system. Exhaust air velocity may not be reduced below the minimum specified in this Section during part-load cooking conditions.

504.8 Separate system required. A separate system and individual duct system shall be provided exclusively for each grease hood, except as provided herein. A single duct system shall serve more than one grease hood located in the same story of the building, provided that, in addition to other requirements of this Code, the installation also complies with the following:

- (a) All hoods served by the system shall be located in the same room or adjacent rooms.
- (b) No portion of the interconnecting duct shall pass through any construction that would require the openings to be fire protected as specified in the *EPCOT Building Code*.
- (c) Grease-exhaust duct systems shall not be interconnected with any other building ventilating or exhaust system.

504.8.1 Solid fuel-exhaust hoods. A separate system and individual duct system shall be provided exclusively for solid fuel-cooking equipment in accordance with Chapter 14 of NFPA 96. When a powered ventilation system is provided, the solid fuel-exhaust system shall be provided with an emergency source of power.

504.9 Enclosure.

504.9.1 Multiple-story buildings. Vertical and horizontal ducts located within a building of two stories or more shall be enclosed in a continuous enclosure extending from the ceiling above the hood to or through the roof. A minimum clearance of 6 inches shall be maintained between the duct and interior surface of the enclosure. The fire-resistance rating of the enclosure shall be a minimum of 1 hour for buildings two through three stories in height, and a minimum of 2 hours for buildings four stories or more in height. The enclosure shall be used exclusively to enclose a single grease-exhaust system and shall be used for no other purposes.

EXHAUST SYSTEMS

504.9.2 Use of calcium silicate. When approved by the Building Official, calcium silicate shall be used in lieu of a duct shaft.

- (a) The minimum temperature rating of the calcium silicate shall be 2,000°F.
- (b) The calcium silicate shall be installed in two, 1-inch layers. All joints and seams shall be staggered and grouted with high-temperature mortar.
- (c) Calcium silicate shall be fastened to the ducts by welded pins or studs with retaining washers. Pins and studs shall be installed on 12-inch centers. Stainless steel bands shall be used on ducts 28 inches and smaller. Bands shall be installed on 8-inch centers.
- (d) The finish coat shall be chicken wire with 1/2-inch continuous coating of high-temperature mortar.
- (e) When listed grease duct enclosures (duct-wrap type) are used, the wrap shall be continuously installed in place from the hood to the duct termination.

504.10 Access to cleanout openings. Openings required in vertical and horizontal enclosures for access to cleanout openings shall be equipped with approved sliding or hinged doors, equal in fire resistance to that of the enclosure, and shall be large enough to facilitate the removal of the cleanout opening cover.

504.11 Dampers. No damper shall be installed in any portion of the duct system unless specifically listed for such use. This does not prohibit the use of dampers that are part of a listed grease extractor, an approved extinguishing system or an approved fan bypass system.

504.12 Clearance to combustibles. Every duct system shall have a clearance from combustible construction of not less than 18 inches. This clearance shall be reduced to not less than 3 inches, provided the combustible material is protected with materials approved for 1-hour fire resistance on the duct side. Ducts shall not pass through interior walls or partitions having a fire-resistance rating of 2 hours or more, unless properly protected with an enclosure of the same rating.

504.13 Motors, fans and exhaust outlets. Motors, fans and exhaust outlets for grease hood duct systems shall comply with all applicable requirements as specified in Sections 403 and 505.

504.14 Devices in duct or hood. Fume incinerators, thermal recovery units, air-pollution control devices or other devices may be installed in ducts or hoods, or located in the path of travel of exhaust products when specifically approved for such use and shall not increase the fire hazard. Downgrading other parts of the exhaust system due to the installation of these approved devices, whether listed or not, shall not be allowed.

504.15 Appliance controls. When the ventilating grease hood system is equipped with power means of exhaust, the appliance control system shall be so interlocked as to permit appliance operation only when the power means of exhaust is in operation.

504.16 Grease duct test. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed. Ducts shall be considered to be concealed where

installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary equipment and perform the grease duct leakage test. A smoke or air pressure test shall be performed to determine that all welded and brazed joints are liquid tight. The test shall be performed for the entire duct system, including the hood-to-duct connection. The duct work shall be permitted to be tested in sections, provided that every joint is tested.

Exception: For listed factory-built grease ducts, this test shall be limited to duct joints assembled in the field and shall exclude factory welds.

SECTION 505 EXHAUST OUTLETS

505.1 Termination. Exhaust outlets for ducts conveying noxious gases, flammable vapors, corrosive vapors, and ducts serving commercial food-cooking and processing equipment, shall terminate outside the building; shall be located 10 feet from any adjacent building, parking area, adjacent property line, window, door or air intake opening; and shall be located a minimum of 10 feet above the adjoining grade level. Every exhaust outlet that is located above the roof shall terminate a minimum of 40 inches above the roof surface. The airflow from exhaust outlets conveying grease-laden vapors shall be in a vertical direction away from the roof surface in accordance with NFPA 96. Where this is not possible, a metal pan a minimum of 1 inch deep shall be provided on the roof surface to catch grease residue. Horizontal exhaust outlets conveying grease-laden vapors shall comply with NFPA 96.

505.2 Recirculation. The exhaust from hoods serving commercial food heat-processing equipment shall terminate in an approved engineered air recovery system for recirculation to the room in which the hood is located.

505.3 Exterior fans. When exterior fans are located outside the roofline, they shall be provided with safe access and a work surface as required for heating equipment in Chapter 3 to allow for inspection, maintenance and cleaning.

505.3.1 Rooftop terminations. Up blast grease-laden-vapor exhaust fans shall be supplied with a service hold-open retainer and flexible weatherproof electrical cable listed for this type of service.

505.3.2 Flex connections. Grease-laden-vapor ductwork and utility set exhaust fan connections shall be made by the use of a 1,500°F-rated flexible connector; or by a flanged connection using a 1 1/2-inch by 1 1/2-inch by 1/8-inch angle and a 1,500°F-rated gasket with 1/4-inch stainless bolts 4 inches on center.

505.3.3 Drain. If the design or positioning of the fan allows grease to be trapped, a drain directed to a readily accessible and visible receptacle, not exceeding 1 gallon, shall be provided. In-line exhaust fans shall be located in an easily accessible area of adequate size to allow for service or removal. If the duct system connected to the fan is in an enclosure, the space or room in which the exhaust fan is located shall have the same fire-resistance rating as the enclosure.

505.3.4 Tests. Exhaust air volumes for hoods shall be of sufficient levels to provide for the capture and removal of grease-laden cooking vapors. Test or performance data acceptable to the Building Official shall be provided upon request for approval.

SECTION 506 COMMERCIAL KITCHEN MAKEUP AIR

506.1 Makeup air. Makeup air shall be supplied during the operation of commercial kitchen exhaust systems that are provided for commercial cooking appliances. The amount of makeup air supplied to the building from all sources shall be approximately equal to the amount of exhaust air for all exhaust systems for the building. The makeup air shall not reduce the effectiveness of the exhaust system. Makeup air shall be provided by gravity or mechanical means or both. Mechanical makeup air systems shall be automatically controlled to start and operate simultaneously with the exhaust system. Makeup air intake opening locations shall comply with Section 404.

506.1.1 Makeup air temperature. The temperature differential between makeup air and the air in the conditioned space shall not exceed 10°F except where the added heating and cooling loads of the makeup air do not exceed the capacity of the HVAC system.

506.2 Compensating hoods. Manufacturers of compensating hoods shall provide a label indicating minimum exhaust flow and/or maximum makeup airflow that provides capture and containment of the exhaust effluent.

Exception: Compensating hoods with makeup air supplied only from the front face discharge and side face discharge openings shall not be required to be labeled with the maximum makeup airflow.

SECTION 507 FIRE-EXTINGUISHING EQUIPMENT

507.1 General. Duct systems, grease removal devices and exhaust hoods serving food heat-processing equipment that produce smoke or grease-laden air shall be protected by both an automatic fire-extinguishing system and a portable extinguisher in accordance with this Section. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment protected by an extinguishing system or located under ventilation equipment protected by an extinguishing system.

507.2 Portable extinguishers. Alkaline dry-chemical-type portable fire extinguishers shall be installed in the kitchen area for the protection of the cooking equipment. Extinguishers shall have a minimum rating of 40B (sodium bicarbonate or potassium bicarbonate base), and shall be conspicuously located and readily accessible along exit paths from the area. The extinguishers shall be a minimum of 10 feet and maximum of 20 feet from the cooking equipment. The top of the extinguishers shall be a maximum of 5 feet above the floor and shall be protected from physical damage.

507.3 Automatic systems. Automatic systems shall be listed specifically for this type of service and shall be installed in accordance with the terms of their listing. A minimum of one manual control for activation shall be located a minimum of 10 feet and a maximum of 20 feet from the cooking equipment, unless an alternative location is specifically approved by the mechanical official. The following types of extinguishing systems shall be provided when installed in accordance with the provisions of the applicable standards and when approved by the Chief Mechanical Inspector.

- (a) NFPA 12, *Carbon Dioxide Extinguishing System*.
- (b) NFPA 13, *Installation of Sprinkler Systems*.
- (c) NFPA 16, *Installation of Foam-Water Sprinkler Systems and Foam-Water Spray Systems*.
- (d) NFPA 17, *Dry-Chemical Extinguishing Systems*.
- (e) NFPA 17A, *Wet-Chemical Extinguishing Systems*.
- (f) Fixed pipe extinguishing equipment conforming to the requirements of NFPA 96.

507.4 Appliance protection. Fat fryers, ranges, griddles, broilers and similar cooking equipment, which may be a source of ignition of grease in the exhaust system, shall also be protected by approved fire-extinguishing equipment.

507.5 Instructions. Fire-extinguishing equipment designed for manual operation shall have instructions posted conspicuously in the kitchen or cooking area.

SECTION 508 RESIDENTIAL RANGE HOODS

508.1 Vents. Residential range hoods, when installed, shall be vented to the outside by a Type B labeled vent or smooth wall duct constructed of a minimum of 0.0157-inch (30 gage) galvanized steel. Vents serving range hoods shall not terminate in an attic, crawl space or any area inside the building. Listed unvented range hoods may be used when installed in accordance with the terms of their listing.

508.2 Clearance. Residential range hoods shall have a vertical clearance above the cooking top of not less than 30 inches to combustible material or metal cabinets, except the clearance may be reduced to not less than 24 inches as follows:

- (a) The underside of the combustible material or metal cabinet above the cooking top is protected with not less than a 1/4-inch insulating millboard covered with sheet metal not less than 0.0122 inch; or
- (b) A metal ventilating hood of sheet metal not less than 0.0122 inch is installed above the cooking top with a clearance of not less than 1/4 inch between the hood and the underside of the combustible material or metal cabinet, and the hood is, at minimum, as wide as the appliance is and is centered over the appliance.

Exception: Clearances defined in this Subsection may be reduced to those of a listed and labeled over-the-stove cooking apparatus.

SECTION 509 CLOTHES DRYERS

509.1 Exhaust ducts—general. Exhaust ducts serving clothes dryers shall comply with the following:

- (a) Ducts shall not be connected to a vent connector, gas vent, chimney, crawl space, attic or other similar concealed space.
- (b) Duct joints shall not be assembled with sheet metal screws or other fastening means that extend into the duct.
- (c) Each joint shall be reasonably sealed with noncombustible material.
- (d) The size and limitations to the length of the exhaust duct shall conform to the manufacturer's installation instructions.
- (e) Dryer exhaust ducts for clothes dryers shall terminate on the outside of the building and shall be equipped with a backdraft damper.

509.2 Exhaust duct material. Exhaust ducts serving residential-type clothes dryers shall be of a material designed, constructed and recommended by the manufacturer for this service.

509.3 Residential exhaust. Residential dryer exhaust ducts that are not designed for a specific dryer shall be constructed of a minimum of 0.0157-inch (30 gage) galvanized steel or other noncombustible material of equivalent strength and corrosion resistance. The ducts shall have a smooth interior finish with joints running in the direction of the airflow. Minimum size of the exhaust duct shall be 4 inches inside diameter. The maximum length shall not exceed 25 feet from the dryer location to the wall or roof cap. There shall be a deduction of 2½ feet for each 45-degree bend and 5 feet for each 90-degree bend. The wall or roof cap shall be non-screened with a backdraft damper and a minimum size of 4 inches. The entire exhaust system shall be properly secured in place.

509.4 Commercial exhaust. Exhaust ducts serving commercial-type clothes dryers shall be constructed of a material equivalent in strength and corrosion resistance to a minimum of 0.0217-inch galvanized steel. Ducts shall have a minimum clearance of 6 inches to combustible materials. Clearance to combustible materials may be reduced, provided the combustible material is protected in accordance with Table 305.

SECTION 510 TIRE REBUILDING OR RECAPPING

510.1 Ventilation. Each room where rubber cement is used or mixed, or flammable or combustible solvents are applied, shall be ventilated in accordance with the applicable provisions of NFPA 91.

510.2 Buffing machines. Each buffing machine shall be connected to a dust-collecting system that prevents the accumulation of the dust produced by the buffing process. The system shall discharge the dust to a suitable container. The system and container shall be cleaned at frequent intervals.

SECTION 511 SUBSLAB SOIL EXHAUST SYSTEMS

511.1 General. When a subslab soil exhaust system is provided, the vent shall meet the requirements of this Section.

511.2 Materials. Subslab soil exhaust system vent material shall be of Class 0 air duct material, or any of the following piping materials that satisfy the *EPCOT Plumbing Code* as drain, waste and vent (DWV) materials: cast-iron, galvanized steel, brass or copper pipe; copper tube of a weight not less than that of copper drainage tube; or Type DWV, plastic piping.

511.3 Grade. Subslab soil exhaust system vent piping shall not be trapped and shall have a minimum slope of 1/8 inch per foot.

511.4 Termination. Subslab soil exhaust system vent piping shall extend through the roof and terminate a minimum of 6 inches above the roof, and a minimum of 10 feet from any operable openings or air intake.

SECTION 512 DRY CLEANING PLANTS

512.1 Air change requirements. The ventilation system for Type I and II systems shall provide a complete and continuous air change a minimum of once every 3 minutes in dry cleaning and dry dyeing rooms. The system shall be provided with means for remote control, and shall operate automatically when any dry cleaning or dry dyeing equipment is in use.

CHAPTER 6

DUCT SYSTEMS

SECTION 601 GENERAL

601.1 Scope. All duct systems used for the movement of air or material in air-conditioning, heating, ventilating, environmental exhaust and conveying systems shall conform to the provisions of this Chapter. See Chapter 4 for ventilating and Chapter 5 for exhaust systems used for the removal of dust, smoke, fumes, gases, vapors, odors, or other hazardous, noxious or injurious impurities.

601.2 Classifications. For the purposes of this Chapter, duct systems shall be classified commercial or residential as defined in Section 202.

601.3 Safety devices. Whenever a fire damper is installed, it shall be installed and constructed to comply with this Chapter. Ducts discharging combustible material directly into any combustion chamber shall conform to the requirements of NFPA 82.

601.4 Personnel protection. Where ventilation duct temperatures exceed 250°F, special protective measures shall be required by the Chief Mechanical Inspector.

601.5 Duct termination. All ducts that connect directly to the outdoors, and do not convey smoke, dust or particulate matter, shall have a bird screen constructed of a minimum 1/4-inch mesh to a maximum 1/2-inch mesh.

SECTION 602 REFERENCED STANDARDS

602.1 Duct and duct systems. Ducts shall be constructed, braced, reinforced and installed to provide structural strength and durability. Ducts and duct systems complying with the requirements of the following applicable referenced standards shall be deemed as meeting the intent of this Code:

- (a) ACCA Manual D, *Duct Design for Residential Winter and Summer Air Conditioning*.
- (b) AACA Manual Q, *Commercial Low-Pressure, Low-Velocity Duct Systems*.
- (c) ADC, *Flexible Duct Performance and Installation Standards*.
- (d) ASHRAE Handbook, *HVAC Systems and Equipment*.
- (e) NAIMA AH 116, *Fibrous Glass Duct Construction Standards*
- (f) NAIMA AH 124, *Fibrous Glass Duct Liner Standard*.
- (g) SMACNA, *Fibrous Glass Duct Construction Standard*.
- (h) SMACNA, *HVAC Duct Construction Standards, Metal and Flexible*.
- (i) UL 181, *Factory-Made Air Ducts and Air Connectors*.
- (j) UL 181A, *Closure Systems for Use with Rigid Air Ducts and Air Connectors*.
- (k) UL 181B, *Closure Systems for Use with Flexible Air Ducts and Air Connectors*.

SECTION 603 DUCT MATERIALS

603.1 Allowable materials. All ducts shall be constructed of iron, steel, aluminum or other approved material.

603.2 Commercial duct systems.

603.2.1 Material limitations. Flexible and rigid, UL 181 Class 0 and 1 duct materials may be used when installed in accordance with the conditions of their listing, provided they are not used for vertical risers serving more than two stories and they are used on duct systems having a maximum air temperature of 250°F. Listed air duct material is not limited in length. Listed flexible air duct material shall be direct and limited to not more than 6 feet, zero inches in length.

603.2.2 Use of building structure. When approved by the Chief Mechanical Inspector, part of the building structure may be used as a duct when installed in accordance with one of the following:

- (a) Duct wall construction consisting of not less than 3/4-inch cement or gypsum plaster on metal lath applied to suitable supports.
- (b) Duct walls of masonry construction of proper strength and design.
- (c) Properly constructed and lined passages of gypsum wallboard shall be used for duct walls for return air and heating ducts in which no condensation is to be encountered.

603.3 Residential duct systems.

603.3.1 Metal ducts. All ducts shall be constructed of metal having a minimum thickness as shown in Table 603.3.

**TABLE 603.3
RESIDENTIAL DUCT MINIMUM THICKNESS**

DIAMETER OR WIDTH (inches)	NOMINAL THICKNESS (inch)	EQUIVALENT GALVANIZED SHEET GAGE NO.	ALUMINUM THICKNESS (inch)
Round ducts:			
14 or less	0.0127	30	0.0183
Over 14	0.0157	28	0.023
Exposed rectangular ducts:			
14 or less	0.0157	28	0.023
Over 14	0.0187	26	0.032

603.3.2 Material limitations. Flexible and rigid, Class 0 and 1 duct materials shall be used for entire duct systems, including plenums serving listed automatic-fired heating equipment having a 250°F temperature limit control when installed in accordance with the conditions of their listing. Listed air duct material is not limited in length.

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603.3.3 Return air ducts. Return ducts, except those portions directly above the heating surface or closer than 2 feet from the heating unit casing, shall be constructed of materials having a flame spread rating not greater than 200.

603.4 Flexible air duct connectors. Flexible air duct connectors shall be used between air ducts and air inlets, air outlets, or air outlet units when they conform to the following provisions:

- (a) Flexible air duct connectors shall conform to the requirements for Class 0 or 1 air connectors when tested in accordance with UL 181. Air connector listing marks shall be round in shape to differentiate between air duct listing marks.
- (b) Class 0 or 1 flexible air duct connectors shall not be used in duct systems containing air at temperatures in excess of 250°F.
- (c) Flexible air duct connectors shall not exceed 14 feet in length.
- (d) Flexible air duct connectors shall not pass through any wall, partition or enclosure of a vertical shaft having a required fire-resistance rating of 1 hour or more.
- (e) Flexible air duct connectors shall not pass through floors.
- (f) Flexible air duct connectors shall be installed in accordance with the manufacturer's installation instructions.

603.5 Prohibited location. Fiber glass duct systems shall be prohibited in food preparation areas and kitchens.

SECTION 604 DUCT CONSTRUCTION AND INSTALLATION

604.1 Joints, seams and connections.

604.1.1 Joint and seam construction. All joints, longitudinal and transverse seams and connections, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes. Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened.

604.1.1.1 Welded joints. Welded joints for longitudinal seams, transverse seams and connections shall meet the requirements of ANSI/AWS D9.1.

604.1.2 Closure systems. Closure systems for use with UL 181 shall be tested and labeled in accordance with the requirements of UL 181A.

604.1.3 Vibration isolation. Vibration isolation connectors between ducts and mechanical systems shall be of an approved flame-retardant fabric, and shall be 10 inches or less in length. On commercial systems, a sleeve joint packed with an approved material having a maximum flame spread rating of 25 and maximum smoke-developed rating of 50 may be used.

604.1.3.1 Separation. A 1-inch-minimum separation shall be maintained between the inside edges of vibration connectors. Vibration isolation connections, when

installed on the exterior of buildings, shall be protected from the elements.

604.1.4 Change of direction. Duct changes of elevation and direction shall be made with full radius degree fittings or elbows. Turning vanes shall be used when space does not allow for full radius.

604.2 Protection. Ducts shall be suitably protected when placed in locations where they may be subject to damage, rupture or corrosion.

604.3 Support. Metal ducts shall be securely supported, hung or suspended by metal hangers, straps, rods, lugs or brackets complying with the duct construction standards referenced in Section 602. Approved nonmetallic ducts and approved duct systems shall be installed and supported in accordance with the terms of their listing. When approved by the Chief Mechanical Inspector, heavy-gage galvanized wire shall be used for supports. When duct static pressure exceeds 2-inch water gage, any piercing of the duct wall to attach the duct to a supporting structure shall be sealed.

604.3.1 Attachments. The lower attachments for sheet metal ducts shall be a minimum of three, No. 10, $\frac{3}{4}$ -inch screws.

604.3.2 Double-wall duct systems. Double-wall duct system hangers shall be spaced a maximum of 6 feet on center with additional supports at the heel of each 90-degree change of direction and at each end run-out.

604.4 Location. Ducts shall not be installed in or within 4 inches of the ground, unless the provisions of Section 606 are met.

604.5 Lighting. Lights or lighting installed within the enclosure of any duct system shall be enclosed fixtures of the marine (vapor-tight) type. Germicidal lamps are not included.

604.6 Weather protection. All ducts, including linings, coverings and vibration isolation connectors, installed on the exterior of the building shall be adequately protected against the elements.

604.6.1 Exterior ductwork. All ductwork located on the exterior of the building shall be a minimum of Schedule G-90 hot-dipped galvanized sheet metal.

604.6.2 Protection of exterior ductwork. All ducts, including linings and vibration isolation connectors, installed on the exterior of the building shall be adequately protected against the elements. All exterior galvanized sheet metal shall be primed with a metal prep solution followed by two coats of an epoxy paint.

604.7 Vertical roof extensions. Ducts passing through the roof and extending 4 feet or more shall require guy wires or other suitable supports as required by the Chief Mechanical Inspector.

SECTION 605 INSULATION

605.1 Materials.

605.1.1 Insulation coverings and linings. Coverings and linings, including adhesives, when used, shall have a

flame spread rating not greater than 25 without evidence of continued progressive combustion and a smoke-developed rating not greater than 50.

605.1.2 Limitations. Duct coverings and linings shall not flame, flow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which it is exposed in service. In no case shall the test temperature be less than 250°F.

605.1.3 Access required. Linings shall be interrupted at the area of operation of a fire damper or fire door.

605.1.4 Proximity to heaters. Linings shall be interrupted for a minimum of 6 inches upstream and 6 inches downstream from electric resistance and fuel-burning heaters in a duct system. (See Subsection 605.2.)

605.1.5 Internal linings. Listed equipment internally lined shall be considered as meeting the requirements of Subsection 605.1.

605.1.6 Prohibited wall or floor penetrations. Duct coverings shall not penetrate a wall or floor required to have a fire-resistance rating or required to be firestopped.

605.1.7 Service openings. Service openings shall not be concealed by duct coverings, unless the exact location of the opening is properly labeled.

605.1.8 Foam plastic. Foam plastic shall conform to Section 717 of the *EPCOT Building Code*.

605.1.9 Insulation markings. External ductwork insulation and factory-insulated flexible ductwork shall be legibly printed or labeled at intervals not greater than 36 inches with the name of the manufacturer, the nominal thickness and density of the insulation or *R*-value, and the flame spread and smoke-developed ratings of the composite materials.

605.2 Installation.

605.2.1 Nonconditioned spaces. Supply air systems and return air systems that are installed in an attic, ventilated crawl space or other nonconditioned area shall be insulated. The Chief Mechanical Inspector may require other ducts to be insulated whenever the sensible and latent temperatures in the duct and unconditioned space could cause condensation on the duct.

605.2.2 Thermal resistance. Insulated ducts and plenums (field-applied or factory-made) shall have an installed thermal resistance (*R*) value of 4.2 minimum based on flat sections of insulation only excluding any air-film resistances. The thermal resistance (*R*) value shall be determined in accordance with Appendix B.

605.2.3 Vapor barrier. When ducts used for cooling are externally insulated, the insulation shall be covered with a vapor barrier having a maximum permeance of 0.05 perms or aluminum foil having a minimum thickness of 2 mils. All insulated exterior ducts shall be properly protected with an approved weatherproof vapor barrier.

605.2.4 Liner interruptions. Where a duct liner has been interrupted, a duct covering of equal thermal performance shall be installed.

605.2.5 Temperature limitations. All ducts that operate at temperatures in excess of 120°F shall have sufficient thermal insulation to limit the exposed surface temperature to 120°F (vapor barrier not required).

605.2.6 Seals. Open-weave fiberglass and mastic shall be used to seal all blanket and board insulation.

605.2.7 Insulation attachment. Vertical ducts extending 16 feet or less that are insulated externally shall be pinned on 18-inch centers. Externally insulated vertical ducts that extend greater than 16 feet shall have a listed adhesive installed in 6-inch bands around the circumference of the ducts.

A minimum of three bands per 4-foot section of duct shall be required and also pinned on 18-inch centers.

SECTION 606 DUCTS IN CONCRETE SLABS

606.1 Materials. Ducts located in or under concrete shall be of metal of sufficient strength encased on all sides with not less than 2 inches of concrete, or shall be of other approved material specifically designed for this service installed in accordance with the manufacturer's installation instructions.

606.2 Slope. Ducts shall slope to an accessible plenum for drainage of condensate.

606.3 Sealing. Ducts shall be properly sealed and secured prior to pouring the concrete encasement.

SECTION 607 DUCT CLEARANCES

607.1 Commercial systems. Metal ducts serving heating equipment shall have a clearance from combustible construction of not less than 1/2 inch. In concealed ceiling, wall and partition spaces where the 1/2-inch clearance cannot be maintained, the interior surfaces of the concealed space shall be protected with 1/4-inch approved insulating material.

607.2 Residential.

607.2.1 Automatically fired heating equipment. Supply ducts serving automatically fired heating equipment equipped with a 250°F temperature limit control shall have a clearance from combustible construction as follows:

- When the heating unit is listed, not less than 2 inches for ducts within 3 feet of the plenum.
- When the heating unit is unlisted, not less than 6 inches for ducts within 6 feet of the plenum.
- Beyond the distances specified in Paragraphs (a) and (b), no clearance is required.

607.2.2 Clearances. Clearances from combustible construction to vertical ducts, risers, boots and register boxes, which connect to ducts within the distances from the plenum specified in Subsection 607.2.1, shall be not less than that specified for the duct.

SECTION 608 PLENUMS

608.1 Plenum chambers.

608.1.1 General. A room, attic, void, hollow or concealed space shall not be used as an integral part of a duct system or plenum, unless the component parts of such space are constructed entirely of noncombustible material, properly protected by means of fire dampers and/or fan cutoff controls so as to restrict the spread of fire, and arranged so as to protect the fire resistance of the assembly. Such chambers shall not be used for storage or occupational purposes. Public exit corridors in hotels, hospitals, institutions and similar occupancies, and in multiple-family dwellings, shall not be used as plenums for adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets and similar auxiliary spaces opening directly on the corridor. Stairway enclosures connecting two or more stories shall not be used as plenums.

Exceptions:

1. This requirement shall not prohibit the use of mechanical ventilation for the corridors or incidental exfiltration because of pressure differential in institutional occupancies.
2. In multiple-family dwellings, hotels and similar occupancies, this requirement shall not prohibit the use of a corridor as a source of makeup air through normal leakage around doors for interior exhaust fans in kitchens, appliances, bathrooms and toilet rooms.
3. Return plenum chambers for residential duct systems as defined in Section 202. Nothing in Subsection 608.1 shall restrict the use of wood-louvered doors; wood-frame mechanical equipment supports; approved plastic-type condensate drain lines; approved plastic fire sprinkler piping, water heater pans and drain lines approved by the *EPCOT Plumbing Code*; and piping insulation installed in mechanical equipment closets, provided all mechanical equipment meets the requirements of Subsection 301.2.
4. Fuel gas lines shall be installed in accessible above-ceiling spaces and crawl spaces, whether or not such spaces are used as a plenum. Gas valves and plumbing waste cleanouts shall not be located within the plenum space.
5. Materials in plenum floor systems serving one- and two-family dwellings, and spaces of 25,000 cubic feet or less in accordance with Subsection 608.2.

608.1.2 Material. Combustible material shall not be used in plenums unless it is properly protected or meets all the standards of Class I duct material, as defined by UL 181.

Exceptions:

1. Thermal and acoustical materials complying with the requirements of Subsections 605.1.1 and 605.1.2.

2. Piping insulation materials complying with the requirements of Subsection 307.1.2.
3. Single- and multiple-conductor, low-voltage and power-limited electrical wire and cables tested in accordance with UL 910; having a peak optical density not greater than 0.50; an average optical density not greater than 0.15; a flame spread rating of 5 feet or less; and classified as having adequate fire-resistance and low smoke-producing characteristics, shall be permitted in concealed spaces, such as spaces over suspended ceilings, plenums, ducts and other spaces used for environmental air-handling purposes. Wiring meeting these requirements shall be listed and labeled as plenum cable.
4. Raceway for fiber optic cable tested in accordance with UL 910, and listed for use in spaces over suspended ceilings, plenums, ducts and other spaces for environmental air handling, shall be permitted, provided that the raceway has a peak optical density not greater than 0.50, an average optical density of 0.15 and a flame spread rating not greater than 5 feet. Optical fiber raceway shall be specifically marked for such use and shall be permitted only with plenum-rated nonconductive-type (OFNP) cable.

608.1.3 Plumbing. The following plumbing items shall not be installed in rooms containing air-handling machinery when such room is used as a plenum:

- (a) Floor drains.
- (b) All plumbing fixtures, except electric water heaters.
- (c) Air admittance valves.
- (d) Water heaters using solid, liquid or gas fuel.
- (e) Cleanouts.

608.2 Plenum floor systems.

608.2.1 General.

608.2.1.1 Crawl space. The use of a crawl space as a plenum shall be restricted as provided herein. Such spaces shall have not less than a 3-inch clearance between the bottom of the floor joists and girders, and the vapor-retarder membrane. Such spaces shall be cleaned of all excess combustible material and shall not be used as a storage area.

608.2.1.2 Materials. The enclosing material, piping and wiring of the under-floor space, including the side-wall insulation, shall meet the requirements of Subsection 608.1.2.

608.2.1.3 Access. Access, if provided to such spaces, shall be through an opening in the floor and shall not be greater than 24 inches by 24 inches.

608.2.1.4 Control limits. The furnace supplying such space shall be equipped with an automatic control having a maximum setting of 150°F, designed to start the furnace fan when the bonnet temperature reaches the setpoint of the control and an approved temperature

limit control designed to limit the outlet temperature to 200°F.

608.2.1.5 Equipment prohibited. Furnaces, boilers or other heat-producing appliances shall not be installed inside the plenum.

608.2.2 Construction practices.

608.2.2.1 Framing. Framing shall comply with the requirements of the *EPCOT Building Code*.

608.2.2.2 Preservatives. Where required, preservatives for decay and termite protection shall be of an approved water-borne type.

608.2.2.3 Chemical treatment. Chemical soil treatment shall be applied to both sides of the foundation wall from the footing to the grade level. Approved chemicals shall be used. All excavations for plumbing and other services shall be completed at the time of the chemical soil treatment, or retreatment shall be necessary.

608.2.2.4 Vapor retarder. After the soil has been treated, a vapor retarder shall be provided within the foundation perimeter, from wall to wall, with joints lapped 4 inches but not sealed. The vapor-retarder membrane shall be carefully fitted around pipes and drains, and turned up at the foundation wall. The vapor-retarder membrane shall be equal to or greater than polyethylene film of 4-mil thickness and a flame spread classification of 200 or less.

608.2.2.5 Receptacle required. A noncombustible receptacle shall be placed below each floor register into the air chamber. Such receptacle shall conform to the following:

- (a) The receptacle shall be securely suspended from the floor members and shall not be more than 18 inches below the opening.
- (b) The size of the horizontal projected area of the receptacle shall extend 3 inches beyond the opening.
- (c) The perimeter of the receptacle shall have a vertical lip a minimum of 1 inch high at the open sides if it is at the level of the bottom of the joints, or 3 inches high if the receptacle is suspended.

608.2.2.6 Foundation insulation. The foundation wall shall be insulated along its inner face from the sill vertically to the under-floor plenum grade level and horizontally over the vapor retarder, a distance of 2 feet. The plenum system shall be insulated to provide a thermal resistance, excluding film resistance, of:

$$R = \frac{3_t}{15}$$

where:

3_t = The temperature difference, in °F, between the design air temperature in the plenum floor system and the outdoor design temperature.

The measurement of R is $\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$.

608.2.2.7 Plenum outlets. Outlets from the plenum shall be provided by one of the following methods:

- (a) Approved air slots, floor registers or wall registers shall be provided.
- (b) Floor registers shall be designed for easy removal in order to provide access for cleaning.
- (c) Wall registers shall be connected to the plenum space with a duct or boot complying with the requirements of this Chapter.

SECTION 609 FIRE PROTECTION OF DUCTS

609.1 Fire dampers.

609.1.1 General. Fire dampers shall comply with the requirements of UL 555 and shall bear the label of an approved testing agency. Fire dampers shall be classified and identified for use in either:

- (a) Static systems that are automatically shut down in the event of fire.
- (b) Dynamic systems that are operating in the event of fire.

609.1.2 Locations. Fire dampers shall be installed in accordance with the manufacturer's installation instructions in the following locations:

- (a) Ducts penetrating walls or partitions having a fire-resistance rating of 1 hour or more.
- (b) Ducts penetrating shaft walls having a fire-resistance rating of 1 hour or more.
- (c) Ducts penetrating only one floor of a building requiring the protection of vertical openings when the duct is not protected by a shaft enclosure as described in Subsection 609.4.

609.1.3 Exceptions. Fire dampers are not required under the following conditions:

- (a) In openings in floors of buildings that do not require protected floor openings.
- (b) Where branch ducts connect to return risers in which the airflow is upward and subducts a minimum of 22 inches long are carried up inside the riser at each inlet.
- (c) In duct systems of any duct material or combinations thereof permitted by this Chapter penetrating 1-hour walls or partitions, where the duct penetrating the rated wall or partition meets the following minimum requirements:

- 1. The duct shall not exceed 100 square inches.
- 2. The duct shall be of 0.0217-inch-minimum steel.
- 3. The duct shall continue with no duct openings for not less than 5 feet from the rated wall.
- 4. The duct shall be installed above a ceiling.

When wall registers occur at the rated wall, a fire damper shall be provided.

609.2 Membrane penetrations. Ducts and air transfer openings constructed of approved materials, in accordance with Chapter 6, that penetrate the ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with one of the following:

1. A shaft enclosure in accordance with the *EPCOT Building Code*.
2. A listed ceiling radiation damper installed at the ceiling line where a duct penetrates the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly. Damper shall comply with Subsection 609.2.1.
3. A listed ceiling radiation damper installed at the ceiling line where a diffuser with no duct attached penetrates the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly. The damper shall comply with Subsection 609.2.1.

609.2.1 Ceiling radiation dampers. Ceiling radiation dampers shall be tested as part of a fire-resistance-rated floor/ceiling or roof/ceiling assembly in accordance with ASTM E119 or UL 263. Ceiling radiation dampers shall be installed in accordance with the details listed in the fire-resistance-rated assembly and the manufacturer's installation instructions and the listing. Ceiling radiation dampers are not required where either of the following applies:

1. Tests in accordance with ASTM E119 or UL 263 have shown that ceiling radiation dampers are not necessary to maintain the fire-resistance rating of the assembly.
2. Where exhaust duct penetrations are located within the cavity of a wall and do not pass through another dwelling unit or tenant space. Duct shall be a minimum 26 ga. sheet steel and penetrations of top/bottom plates shall be properly fire caulked. (Provide penetration details on plans.)

609.3 Smoke dampers.

609.3.1 Location. An approved damper designed to resist the passage of smoke shall be installed in accordance with the manufacturer's installation instructions at each air-transfer opening or duct penetration of a required smoke barrier.

609.3.2 Smoke barriers. Smoke dampers located in ducts that penetrate smoke barriers shall close upon detection of smoke by smoke detectors that are:

- (a) Installed in accordance with NFPA 72.
- (b) Located on either side of a smoke barrier door opening where ducts penetrate smoke barriers above the door opening.
- (c) Located within the ductwork of existing installations.

609.3.3 Activation. Required smoke dampers in air-transfer openings shall close upon detection of smoke by smoke detectors that are installed in accordance with NFPA 72.

609.3.4 Where not required. Smoke dampers are not required under the following conditions:

- (a) Ducts or air-transfer openings that are part of an engineered smoke control system.

- (b) Ducts where the air continues to move and the air-handling system is arranged to prevent the recirculation of exhaust or return air under a fire emergency condition.

- (c) Air inlet or outlet openings in ducts that are limited to a single smoke compartment.

- (d) Ducts that penetrate floors that serve as smoke barriers.

609.4 Floor penetration. In buildings greater than one story in height, ducts extending through more than one floor shall be protected by a shaft enclosure having a fire-resistance rating of not less than 1 hour for buildings less than four stories in height and not less than 2 hours for buildings four stories or greater in height. Ducts penetrating only one floor may be protected by installing a listed fire damper where the floor is pierced in lieu of the enclosure.

609.5 Means of access. An access door or other approved means of access shall be provided in ducts to permit the proper maintenance and resetting of each fire door, fire damper and smoke damper. For ducts located above the ceiling of a fire-rated assembly, a service opening designed and installed so as not to reduce the fire rating of the assembly shall be provided.

609.6 Location and installation details. The specific location and installation details of each fire door, fire damper, ceiling damper and smoke damper shall be shown and properly identified on the building plans.

609.7 Corridors. A listed smoke damper designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a corridor enclosure required to have fire rated doors of 20 minutes or greater in accordance with the *EPCOT Building Code*. Smoke dampers and smoke damper actuation methods shall comply with Subsection 609.7.1.

Exceptions:

1. Smoke dampers are not required in corridor penetrations where the penetration is part of an approved smoke control system installed in accordance with the *EPCOT Building Code* and smoke dampers are not necessary for the operation and control of the system.
2. Smoke dampers are not required in smoke barrier penetrations where the openings in ducts are limited to a single smoke compartment and the ducts are constructed of steel.
3. Smoke dampers are not required in corridor penetrations where the duct is constructed of steel not less than 0.019 inch in thickness and there are no openings serving the corridor.

609.7.1 Smoke dampers. The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with the *EPCOT Building Code*, NFPA 72 and one of the following methods, as applicable:

1. Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 5 feet of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed.

2. Where a damper is installed above smoke barrier doors in a smoke barrier, a spot-type detector listed for releasing service shall be installed on either side of the smoke barrier door opening.
3. Where a damper is installed within an unducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5 feet horizontally of the damper.
4. Where a damper is installed in a corridor wall, the damper shall be permitted to be controlled by a smoke detection system installed in the corridor.
5. Where a total-coverage smoke detector system is provided within all areas served by an HVAC system, dampers shall be permitted to be controlled by the smoke detection system.

609.8 Through penetrations. In occupancies other than Groups D-1 and D-2, a duct constructed of approved materials in accordance with Chapter 6 that penetrates a fire-resistance-rated floor/ceiling assembly that connects not more than two stories is permitted without shaft enclosure protection provided that a listed fire damper is installed at the floor line.

Exception: A duct is permitted to penetrate three floors or less without a fire damper at each floor provided it meets all of the following requirements.

1. The duct shall be contained and located within the cavity of a wall and shall be constructed of steel having a thickness of not less than 0.0187 inch (No. 26 gage).
2. The duct shall open into only one dwelling unit or sleeping unit and the duct system shall be continuous from the unit to the exterior of the building.
3. The duct shall not exceed 4-inch nominal diameter and the total area of such ducts shall not exceed 100 square inches for any 100 square feet of the floor area.
4. The annular space around the duct is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E119 or UL 263 time-temperature conditions under a minimum positive pressure differential of 0.01 inch of water at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.
5. Grille openings located in a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with a listed ceiling radiation damper installed in accordance with Subsection 609.2.

609.9 Shaft enclosures. Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with approved fire and smoke dampers installed in accordance with their listing.

Exceptions:

1. Fire dampers are not required at penetrations of shafts where one of the following conditions exists:
 - 1.1. Steel exhaust subducts extend not less than 22 inches vertically in exhaust shafts provided that

there is a continuous airflow upward to the outdoors.

- 1.2. Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.
- 1.3. Ducts are used as part of an approved smoke control system in accordance with the *EPCOT Building Code*, and where the fire damper will interfere with the operation of the smoke control system.
- 1.4. The penetrations are in parking garage exhaust or supply shafts that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
2. In Group B and R occupancies equipped throughout with an automatic sprinkler system in accordance with the *EPCOT Building Code*, smoke dampers are not required at penetrations of shafts where kitchen, clothes dryer, bathroom and toilet room exhaust openings with steel exhaust subducts, having a thickness not less than 0.0187 inch (No. 26 gage), extend not less than 22 inches vertically and the exhaust fan at the upper terminus is powered continuously in accordance with the provisions of the *EPCOT Building Code* for emergency power systems, and maintains airflow upward to the outdoors.
3. Smoke dampers are not required at penetrations of exhaust or supply shafts in parking garages that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
4. Smoke dampers are not required at penetrations of shafts where ducts are used as part of an approved mechanical smoke control system designed in accordance with the *EPCOT Building Code* and where the smoke damper will interfere with the operation of the smoke control system.
5. Fire dampers and combination fire/smoke dampers are not required in kitchen and clothes dryer exhaust systems installed in accordance with this Code.

609.9.1 Enclosure at the bottom. Shaft enclosures that do not extend to the bottom of the building or structure shall be protected in accordance with the *EPCOT Building Code*.

SECTION 610 WEATHERPROOFING

610.1 General. All ducts installed outside buildings and exposed to the elements shall be properly weatherproofed in an approved manner. Ducts with internal insulation shall have all joints and seams soldered or otherwise sealed so as to be weather tight. Ducts externally insulated shall have this insulation protected with a covering of sheet metal or a weather-proof membrane, all of which shall be applied in an approved manner. Ducts and plenums that communicate with the outside atmosphere shall not be insulated internally.

DUCT SYSTEMS

Sheet metal coverings on exterior ducts shall be the standing-seam type, and all seams and joints shall be made water tight.

Exception: Ducts and plenums that are required to be insulated for sound-deadening reasons shall be insulated with a moisture-resistant, nonabsorbent material.

SECTION 611 AIR FILTERS

611.1 General. All heating and air-conditioning systems of the central type shall be provided with approved-type air filters. Filters shall be installed in the return airflow, upstream from any heat exchanger or coil, in an approved convenient location, and shall be easily accessible for cleaning or replacement. Filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid adhesive coatings used on filters shall have a flash point not lower than 325°F.

Exception: Fan-powered induction units, induction units and heating fans using integral electric heater or electric duct heating coils, which are located above ceilings or in return air ceiling plenums, may omit filters, provided they are conveying previously filtered air from a central-type air-conditioning unit that also serves the occupied space.

611.2 Approval. Media-type and electrostatic-type filters shall be listed and labeled. Air filters utilized within dwelling units shall be designed for the intended application, and shall not be required to be listed and labeled.

611.3 Airflow over the filter. Ducts shall be constructed to allow the even distribution of air over the entire filter.

SECTION 612 DUCTS FOR VENTILATION AIR SUPPLY SYSTEMS

612.1 General. In addition to other requirements listed in this Chapter, ducts for ventilation air supply systems shall satisfy the requirements of this Section.

612.2 Sealing. Ducts shall be substantially air tight throughout and have no openings other than those required for the proper operation and maintenance of the system.

612.3 Attachment. Every duct shall be securely attached to the building as set forth in this Chapter. No nails or screws shall be driven through the duct walls into the building construction, and ducts shall be supported on noncombustible straps or hangers without penetrating the duct walls.

612.4 Cleaning. Every duct or plenum, which is a portion of a ventilation system used for exhausting any solid particles, shall be constructed so as to permit thorough cleaning of the entire duct system. Any such duct or plenum, having any section or sections inaccessible from the duct entry or discharge, shall be provided with cleanout openings. All cleanout openings shall be equipped with tight-fitting, sliding or hinged doors, constructed of metal equal or greater in thickness than the ducts. Such doors shall be equipped with a substantial method of latching, sufficient to hold the door tightly closed.

These doors shall be so designed that they can be opened easily without the use of a tool.

SECTION 613 DUCTS FOR EXHAUST SYSTEMS

613.1 General. In addition to other requirements listed in this Chapter, ducts for exhaust systems shall satisfy the requirements of this Section.

613.2 Materials. Materials shall be of nonabsorbent, and moisture- and corrosion-resistant character. The design and construction of all equipment, and the weight and bracing of all ductwork, shall be such that the ductwork will operate under normal conditions without excessive vibrations. Ducts shall be substantially air tight. Linings, if used, shall be securely anchored.

SECTION 614 DUCTS FOR COMBUSTION AIR

614.1 General. In addition to other requirements listed in this Chapter, ducts for combustion air systems shall satisfy the requirements of this Section.

614.2 Materials and termination. Ducts required for combustion air shall be of galvanized steel, or other corrosion-resistant material approved for this use, and terminate in a space not less than 6 inches deep in front of, or open to, the front or firebox side of the appliance. Every such space shall extend from the floor to the ceiling of the appliance enclosure. Combustion air openings shall be covered with a corrosion-resistant screen of not less than 1/4-inch mesh.

CHAPTER 7

COMBUSTION AIR

SECTION 701 GENERAL

701.1 Scope. This Chapter is intended to ensure the adequate supply of combustion air to fuel-burning equipment.

701.2 Direct-vent systems. The provisions set forth in this Chapter define the minimum requirements of air for combustion and ventilation. These provisions are not intended to apply to direct-vent systems, which are constructed and installed in accordance with the manufacturer's specifications so that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere. These standards shall not be decreased; however, manufacturer's specifications shall be followed where their requirements exceed these standards.

701.3 Maximum room temperature. To prevent space temperatures from exceeding 120°F, additional ventilation air shall be supplied to the equipment room. Equipment rooms shall not be ventilated by any means that would reduce pressures in the space sufficiently to draw gases of combustion from the appliance into the equipment room.

701.4 Minimum dimensions. The minimum dimension of rectangular air ducts shall be 3 inches.

701.5 Ducts—general. The materials used in combustion air systems shall be constructed of approved material and construction as set forth in Chapter 6.

SECTION 702 SOLID FUEL EQUIPMENT

702.1 Minimum openings. Rooms or spaces, in which an appliance or appliances arranged to burn solid fuel are installed, shall be provided with minimum unobstructed combustion air openings equal to 2 square inches for each 1,000 Btu per hour (Btu/h) fuel-input rating of such appliances with a minimum total free area of 200 square inches as specified in Section 703.

SECTION 703 LIQUID AND GAS FUEL EQUIPMENT

703.1 Air for combustion and ventilation. Rooms or spaces in which gas or liquid fuel-burning appliances are installed shall be provided with minimum unobstructed combustion air openings in accordance with the provisions of this Section.

703.2 Unconfined spaces.

703.2.1 General. Where appliances are installed in unconfined spaces, in buildings of conventional frame, brick or stone construction having air infiltration, air for combustion and draft hood dilution is adequately obtained normally by infiltration.

703.2.2 Unusually tight construction. Where appliances are installed in unconfined spaces, within a building of

unusually tight construction, air for combustion, ventilation and draft hood dilution must be obtained from the outdoors or from spaces freely connected with the outdoors. Under these conditions, a permanent opening or openings shall be provided, located and sized in compliance with the provisions of Subsection 703.4.2 or 703.4.3.

703.3 Confined spaces. Where appliances are installed in a confined space, provisions shall be made for supplying this space with air for combustion and ventilation. This may be accomplished through the use of two permanent openings freely connected with additional rooms of sufficient volume for which the combined volume of all spaces meets the criteria for an unconfined space, or by complying with the provisions of Subsection 703.4. The total input of all appliances installed in the confined space shall be considered in making this determination. The two permanent openings shall each have a free area of not less than 1 square inch per 1,000 Btu/h of input rating of all appliances in the confined space, but not less than 100 square inches. One opening shall be within 12 inches of the top of the confined space and one within 12 inches of the bottom. If necessary, continuous ducts having cross-sectional areas that are, at minimum, equal to the free area of the opening shall be utilized to connect with the source of air supply. The minimum dimensions of rectangular air ducts shall be not less than 3 inches. Any duct from the top opening must be horizontal or pitched upward.

Exception: Where appliances are installed in a confined space within a one- or two-family residence, provisions may be made for supplying this space with air for combustion and ventilation by eliminating the ceiling of the confined space, provided, however, that the area above this confined space has openings directly to outside air as required by Subsection 703.4.

703.4 Combustion air from outdoors.

703.4.1 Confined spaces. Where appliances are installed in a confined space, and all air for combustion and ventilation is obtained from outdoors, the confined space shall be provided with one or two permanent openings, in compliance with the provisions of Subsection 703.4.2 or 703.4.3.

703.4.2 Confined spaces with one opening. When one opening is used and the appliance has a minimum clearance of 1 inch on the sides and back, and 6 inches on the front, the opening shall be within 12 inches of the top of the confined space. The opening shall connect directly, or by ducts, with the outdoors or spaces (attic) that freely connect with the outdoors, as follows:

- (a) When connecting with the outdoors through an opening, or vertical or horizontal duct, the opening shall have a minimum free area of 1 square inch per 3,000 Btu/h of the input rating of all appliances in the enclosure, but not smaller than the vent flow area.

- (b) When a duct is used, it shall have, at minimum, the same cross-sectional area as the free area of the openings to which it connects. The minimum dimension of the rectangular air duct shall be not less than 3 inches.
- (c) In calculating free area, consideration shall be given to the blocking effect of a louver, grille or screen protecting the opening.
- (d) The duct or opening for combustion or ventilation air shall be covered with a corrosion-resistant screen of not less than 1/4-inch mesh.

703.4.3 Confined spaces with two openings. When two openings are provided, one opening shall be within 12 inches of the top and one within 12 inches of the bottom of the enclosure, with each opening having a minimum free area of 19 square inches. The openings shall connect directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely connect with the outdoors, subject to the following:

- (a) When directly connecting with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/h of total input rating of all appliances in the enclosure.
- (b) When connecting with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/h of total input rating of all appliances in the enclosure.
- (c) When connecting with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch per 2,000 Btu/h of total input rating of all appliances in the enclosure.
- (d) When ducts are used, they shall have, at minimum, the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches. Any duct from the top opening must be horizontal or pitched upward.
- (e) In calculating free area, consideration shall be given to the blocking effect of louvers, grilles or screens protecting openings.

703.5 Alternative methods of supply. Alternative methods of supplying combustion air may be approved when special engineering ensures an adequate supply of air for combustion, ventilation and draft hood dilution by mechanical means. Such mechanical systems shall be as approved by the Chief Mechanical Inspector and shall supply outside air to the space. In no case shall exhaust fans be used that will create a negative pressure in a space where gas or liquid fuel-burning appliances are installed.

SECTION 704 OPENING OBSTRUCTIONS

704.1 General. The required size of openings for combustion and ventilation air shall be based on the net free area of each opening. The net free area of an opening shall be that specified by the manufacturer of the opening covered. In the

absence of such information, openings covered with metal louvers shall be deemed to have a net free area of 75 percent of the area of the opening, and openings covered with wood louvers shall be deemed to have a net free area of 25 percent of the area of the opening.

704.2 Dampened openings. Where the combustion air openings are provided with volume, smoke or fire dampers, the dampers shall be electrically interlocked with the firing cycle of the appliances served, so as to prevent the operation of any appliance that draws combustion and ventilation air from the room when any of the dampers are closed. Manually operated dampers shall not be installed in combustion air openings.

SECTION 705 OPENING LOCATION AND PROTECTION

705.1 General. Combustion air openings to the outdoors shall comply with the location and protection requirements of Section 404 applicable to outside air intake openings.

CHAPTER 8

CHIMNEYS AND VENTS

SECTION 801 GENERAL

801.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of chimneys and vents.

801.2 Required installations. Chimneys shall be required for all heating or heat-producing appliances, except electrical heating and appliances listed for use with venting systems. Every chimney shall be constructed, and every venting system shall be installed in accordance with the applicable requirements of this Chapter. Every chimney, vent or venting system shall be capable of producing a draft at the appliance not less than that required for the safe operation of the appliance connected hereto.

801.3 Power exhauster. A power exhauster shall be used, except with incinerators, to increase low draft. When an exhauster is used, provisions shall be made to shut off the fuel supply to the appliance in the event of failure of the exhauster.

801.4 Joining of connectors.

801.4.1 Combined connectors. Nothing in this Code shall prohibit the joining of two or more connectors into a combined connector, provided that all pipes are of sufficient size to serve all of the appliances thus connected, and provided that all pipes are constructed to comply with the most restrictive requirements of any of those connected.

801.4.2 Prohibited connections. The connector of a fuel-burning appliance shall not be connected into the chimney flue of an incinerator that has the rubbish chute combined with the chimney flue.

801.5 Use of plastic pipe for venting. Approved plastic pipe shall be used for venting condensing-type furnaces and boilers in accordance with the appliance manufacturer's installation instructions.

801.6 Single-wall chimney. A single-wall chimney shall not pass through an attic or other normally unoccupied space.

801.7 Gas venting systems. Venting systems for natural gas, liquefied petroleum gas (LP-gas) and propane systems shall be constructed and installed in accordance with the *EPCOT Fuel Gas Code*.

801.8 Minimum and maximum size of chimney or vent.

801.8.1 Minimum size. Except as otherwise provided in this Chapter, the cross-sectional area of a flue within a chimney or vent shall be equal to or greater than the cross-sectional area of the appliance flue collar or draft hood outlet.

801.8.2 Maximum size. The cross-sectional area of a flue serving a solid fuel-burning appliance shall be not greater than three times the cross-sectional area of the appliance flue collar or flue outlet.

SECTION 802 CONSTRUCTION REQUIREMENTS

802.1 Support. A chimney shall not carry any load other than its own dead weight.

802.2 Crickets. Chimney crickets of metal or other roofing materials shall be laid or installed on solid roof decking consistent with the construction of the roof.

802.3 Unsafe chimneys. All unsafe or dangerous chimneys shall be made safe or taken down.

802.4 Termination. Chimneys shall extend a minimum of 3 feet above the highest point where they pass through the roof of the building and a minimum of 2 feet higher than any portion of the roof located within 10 feet horizontally of such chimney.

802.5 Positive pressure. An appliance equipped with a forced or induced draft system, which may result in positive pressure in the venting system, shall be connected to a pressure-tight venting system.

802.6 Renovation and new construction.

802.6.1 Adjacent chimneys and vents. Whenever a building is hereafter erected, enlarged or raised, the owner of such building shall, at his own expense, carry up, either independently or on his own building, all chimneys, smokestacks and smoke flues of an adjoining building that is within 10 feet of any portion of the wall extending above such chimney or flue. The construction of such chimney shall conform to all the requirements of this Code. The chimney shall be carried up simultaneously with the walls.

802.6.2 Required notice. It shall be the duty of the owner of the building to be erected, enlarged or raised to give notice of his intention to carry up such chimney to the owner of the chimney affected. Such notice shall be in writing and submitted a minimum of 10 days before such work is to begin.

SECTION 803 FACTORY-BUILT CHIMNEYS

803.1 Listing. Factory-built chimneys shall be listed, and shall be installed in accordance with the conditions of the listing and the manufacturer's installation instructions.

803.2 Closed combustion chambers. Factory-built chimneys for use with closed combustion, wood-burning appliances shall comply with the requirements of UL 103.

803.3 Factory-built fireplaces. Chimneys for use with factory-built fireplaces shall meet the requirements of UL 127.

803.4 Insulated, suspended chimneys. Nothing contained in this Code shall be construed as prohibiting the use of insulated, suspended factory-built chimneys, provided such assemblies have been tested and approved by a recognized laboratory for the use intended and are installed in accordance with their approval.

803.5 Clearance. Factory-built chimneys shall be installed with zero clearance on wood structural members, such as framing, roof rafters, floor and ceiling joists, and other component structural members, when it has been determined by test reports of recognized and approved testing laboratories that the unit does not transmit heat to the supporting combustible members that is greater than 90°F above room temperature. All chimney installations shall conform to the height requirements of this Code.

803.6 Support. Supports for such chimneys attached to ceiling or floor joists shall be permitted, provided the joists are of adequate size to support additional load.

SECTION 804 MASONRY CHIMNEYS

804.1 Support. Masonry chimneys shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire-resistance rating of not less than 3 hours shall be used to support masonry chimneys where such supports are independent of the floor construction and the load transferred to the ground.

804.2 Corbeling. Masonry chimneys shall not be corbeled more than 6 inches from a wall, nor shall a chimney be corbeled from a wall that is less than 12 inches thick, unless it projects equally on each side of the wall, provided that in the second story of a two-story dwelling, corbeling of chimneys on the exterior of the enclosing walls shall equal the wall thickness. Individual corbels or the maximum projection of one unit shall not exceed one-half the height of the unit nor one-third its bed depth. Corbeled smoke chambers shall be purged with fire-clay mortar or refractory mortar.

804.3 Flue. A chimney or chimney flue shall not change in size or shape within 6 inches above or below where the chimney passes through floor components, ceiling components or roof components.

804.4 Cleanouts. Cleanout openings provided in chimneys shall be equipped with ferrous metal doors and frames arranged to remain tightly closed when not in use. Adequate clearance between cleanout doors and combustible material shall be provided.

804.5 Firestopping. All spaces between chimneys, and floors and ceilings through which chimneys pass, shall be firestopped with noncombustible material. The firestopping of spaces between chimneys, and wood joists, beams or headers shall be to a depth of 1 inch only, and placed on strips of metal or metal lath laid across the spaces between the combustible material and the chimney.

804.6 Testing. Masonry chimneys shall be proved tight by a smoke test after erection and before being put into use.

SECTION 805 MASONRY CHIMNEYS FOR RESIDENTIAL-TYPE APPLIANCES

805.1 Construction. Masonry chimneys shall be constructed of solid masonry units or reinforced concrete, with walls not less than 4 inches thick or rubble stone masonry not less than 12 inches thick.

805.2 Liners.

805.2.1 Masonry chimneys. Masonry chimneys for residential-type appliances shall be lined with approved fire-clay tile flue liners not less than $\frac{5}{8}$ inch thick, or with other approved liners of material that will resist corrosion, softening or cracking from flue gases at temperatures less than or equal to 1,800°F. Fire-clay tile liners shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire-clay or refractory air-setting mortar with close-fitting joints left smooth on the inside.

805.2.2 Liner separation. Liners shall be separate from the chimney wall, and the space between the liner and masonry shall not be filled. Only enough mortar shall be used to make a good joint and hold the liners in position.

805.2.3 Extent of liner. Flue liners shall start from a point not less than 8 inches below the intake. They shall extend as nearly vertical as possible for the entire height of the chimney, and shall extend a minimum of 4 inches above the crown of the chimney, but not greater than 6 inches.

805.2.4 Staggered joints. Where two adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered a minimum of 7 inches.

805.2.5 Flue separations. Where more than two flues are located in the same chimney, masonry wythes (partitions) a minimum of 4 inches wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two flues in any group of adjoining flues without such wythe separation.

805.2.6 Listed lining systems. Lining systems, other than fire-clay tile flue liners, shall be listed in accordance with UL 1777 or equivalent, and shall be installed in accordance with the terms of the listing and the manufacturer's installation instructions.

805.2.7 Prohibited vents. The space surrounding a flue lining system, or other vent installed within a masonry chimney, shall not be used to vent any other appliance. This shall not prevent the installation of a separate flue lining in accordance with the manufacturer's installation instructions and this Code.

805.3 Termination. Masonry chimneys for residential-type appliances shall extend a minimum of 3 feet above the highest point where they pass through the roof of a building and a minimum of 2 feet higher than any portion of a building within 10 feet.

805.4 Clearance. Any portion of a masonry chimney located within the outer surface of the building envelope shall have a minimum airspace clearance of 2 inches to combustible material. Chimneys located entirely outside the exterior walls of the building, including chimneys that pass through the soffit or cornice, shall have a minimum airspace clearance of 1 inch. The airspace shall not be filled, except to provide firestopping in accordance with Subsection 804.5.

Exception: Airspace clearance shall not be required where the masonry chimney is equipped with a chimney lining system listed for use in chimneys in contact with combus-

tibles in accordance with UL 1777, and the lining system is installed in accordance with the manufacturer's installation instructions. Noncombustible firestopping shall be provided in accordance with Subsection 804.5.

SECTION 806 MASONRY CHIMNEYS FOR LOW-HEAT APPLIANCES

806.1 Construction. Masonry chimneys shall be constructed of solid masonry units or reinforced concrete, with walls not less than 8 inches thick, except that rubble stone masonry shall be not less than 12 inches thick.

806.2 Liners.

806.2.1 Masonry chimneys. Masonry chimneys for low-heat appliances shall be lined with approved fire-clay tile flue liners not less than $\frac{5}{8}$ inch thick, or with other approved liners of material that will resist corrosion, softening or cracking from flue gases at temperatures less than or equal to 1,800°F. Fire-clay tile liners shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire-clay or refractory air-setting mortar with close-fitting joints left smooth on the inside.

806.2.2 Extent of liner. Flue liners shall start from a point not less than 8 inches below the intake. They shall extend as nearly vertical as possible for the entire height of the chimney, and shall extend a minimum of 4 inches above the crown of the chimney, but not greater than 6 inches.

806.2.3 Staggered joints. Where two adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered a minimum of 7 inches.

806.2.4 Flue separations. Where more than two flues are located in the same chimney, masonry wythes (partitions) a minimum of 4 inches wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two flues in any group of adjoining flues without such wythe separation.

806.3 Termination. Masonry chimneys for low-heat appliances shall extend a minimum of 3 feet above the highest point where they pass through the roof of a building and a minimum of 2 feet higher than any portion of a building within 10 feet.

806.4 Clearance. Any portion of a masonry chimney located within the outer surface of the building envelope shall have a minimum airspace clearance of 2 inches to combustible material. Chimneys located entirely outside the exterior walls of the building, including chimneys that pass through the soffit or cornice, shall have a minimum airspace clearance of 1 inch. The airspace shall not be filled, except to provide firestopping in accordance with Subsection 804.5.

Exception: Airspace clearance shall not be required where the masonry chimney is equipped with a chimney lining

system listed for use in chimneys in contact with combustibles in accordance with UL 1777, and the lining system is installed in accordance with the manufacturer's installation instructions. Noncombustible firestopping shall be provided in accordance with Subsection 804.5.

SECTION 807 MASONRY CHIMNEYS FOR MEDIUM-HEAT APPLIANCES

807.1 Construction. Masonry chimneys for medium-heat appliances shall be constructed of solid masonry units or reinforced concrete, each not less than 8 inches thick, except that stone masonry shall be not less than 12 inches thick; and, in addition, shall be lined with not less than $4\frac{1}{2}$ inches of firebrick laid on a $4\frac{1}{2}$ -inch bed in fire-clay mortar, starting not less than 2 feet below the chimney connector entrance and extending for a distance that is a minimum of 25 feet above the chimney connector entrance. Chimneys extending 25 feet or less above the chimney connector shall be lined to the top.

807.2 Termination. Masonry chimneys for medium-heat appliances shall extend not less than 10 feet higher than any portion of any building within 25 feet, and shall have a clearance of 2 inches from buildings and structures.

SECTION 808 MASONRY CHIMNEYS FOR HIGH-HEAT APPLIANCES

808.1 Construction. Masonry chimneys for high-heat appliances shall be constructed with double walls of solid masonry units or reinforced concrete, each not less than 8 inches thick, with an airspace of not less than 2 inches between them. The inside of the interior walls shall be of firebrick not less than $4\frac{1}{2}$ inches thick laid on a $4\frac{1}{2}$ -inch bed in fire-clay mortar.

808.2 Termination. Masonry chimneys for high-heat appliances shall extend not less than 20 feet higher than any portion of any building within 50 feet; and shall have sufficient clearance from buildings and structures to avoid overheating combustible material; to permit inspection; to permit maintenance operations on the chimney; and to avoid the danger of burns to persons. Clearances shall be based on good engineering practice, and shall be approved by the Chief Mechanical Inspector.

SECTION 809 METAL CHIMNEYS (SMOKESTACKS)

809.1 Construction. Metal chimneys shall be of adequate thickness based on good engineering practice, properly riveted or welded, and securely supported. When selecting the thickness of metal chimneys, consideration should be given to factors such as location, maintenance, use, etc., as well as engineering design factors. See Table 809 for the thicknesses of uncoated sheet steel based on a given cross-sectional area.

TABLE 809
MINIMUM THICKNESS OF UNCOATED
SHEET STEEL BASED ON AREA OF CHIMNEY

THICKNESS (inch)	AREA (square inches)
0.0598	Up to 154
0.0747	154 to 201
0.105	201 to 254
0.135	Larger than 254

809.2 Ventilation ducts. Metal chimneys shall not be carried up inside of ventilation ducts, unless such ducts are constructed and installed as required by this Code for chimneys, and the ventilation ducts are used solely for the exhaust of air from the room or space in which the appliance served by the metal chimney is located.

809.3 Clearance. Metal chimneys shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection and maintenance operations on the chimneys, and to avoid the danger of burns to persons.

SECTION 810 **METAL CHIMNEYS FOR** **LOW-HEAT APPLIANCES**

810.1 Termination.

810.1.1 Height. Metal chimneys for residential-type, low-heat appliances without an exhauster shall extend a minimum of 3 feet above the highest point where they pass through the roof of a building and a minimum of 2 feet higher than any portion of a building within 10 feet. The outlet of a metal chimney for residential-type and low-heat appliances equipped with an exhauster shall terminate at a location not less than 3 feet from an adjacent building or building opening, and a minimum of 10 feet above grade or walkways. In any case, the outlet shall be so arranged that the flue gases are not directed so as to jeopardize people, overheat combustible structures or enter building openings in the vicinity of the outlet.

810.1.2 Clearance to openings. An exterior metal chimney shall not be nearer than 24 inches to any door or window, or to any walkway, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

810.2 Clearance.

810.2.1 Wood frame construction. Exterior metal chimneys used only for residential-type, low-heat appliances, as defined in Table 810, shall have a clearance of not less than 6 inches from a wall of wood frame construction and from any combustible material.

810.2.2 Other construction. Exterior metal chimneys more than 18 inches in diameter shall have a clearance of not less than 4 inches, and those 18 inches or less in diameter shall have a clearance of not less than 2 inches from a building wall of other than wood frame construction.

810.2.3 Wall clearance. Where a metal chimney used for residential-type construction, as defined in Table 810, is located in the same story of a building as that in which the appliances connected thereto are located, it shall have a clearance of not less than 18 inches from a wall of wood frame construction and from any combustible material.

810.2.4 Roof penetrations. Where a metal chimney serving only low-heat appliances, as defined in Table 810, passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of noncombustible material, of galvanized iron or approved corrosion-resistant metal, extending not less than 9 inches below and 9 inches above the roof construction, and of a size to provide not less than a 6-inch clearance on all sides of the chimney; or the combustible material in the roof construction shall be cut away so as to provide not less than an 18-inch clearance on all sides of the chimney, with noncombustible material used to close up such opening entirely.

810.3 Multiple-story installation.

810.3.1 Walls required. Where a metal chimney extends through any story above that in which the appliances connected to the chimney are located, it shall be enclosed in such upper stories with walls of noncombustible construction having a fire-resistance rating of not less than 1 hour.

810.3.2 Clearspace. The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair.

810.3.3 Opening protection. The enclosing walls shall be without openings, except doorways equipped with approved, self-closing fire doors at various floor levels for inspection purposes.

SECTION 811 **METAL CHIMNEYS FOR** **MEDIUM-HEAT APPLIANCES**

811.1 Termination.

811.1.1 Height. Metal chimneys for medium-heat appliances shall extend not less than 10 feet higher than any portion of any building within 25 feet.

811.1.2 Clearance to openings. Portions of an exterior metal chimney shall not be nearer than 24 inches to any door or window, or to any walkway, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

811.2 Clearance.

811.2.1 Wall clearance. Exterior metal chimneys used for medium-heat appliances, as defined in Table 810, shall have a clearance of not less than 24 inches from a wall of wood frame construction and from any combustible material.

811.2.2 Other construction. Exterior metal chimneys greater than 18 inches in diameter shall have a clearance of not less than 4 inches, and those 18 inches or less in diameter shall have a clearance of not less than 2 inches from a building wall of other than wood frame construction.

TABLE 810
CHIMNEY SELECTION CHART^c

CHIMNEYS FOR RESIDENTIAL-TYPE APPLIANCES	CHIMNEYS FOR LOW-HEAT APPLIANCES	CHIMNEYS FOR MEDIUM-HEAT APPLIANCES	CHIMNEYS FOR HIGH-HEAT APPLIANCES ^a
1. Factory-built (residential) ^{f, g} 2. Masonry (residential) ^d	1. Factory-built (low-heat) 2. Masonry (low-heat type) ^d 3. Metal (smokestack) ^e	1. Factory-built (medium-heat type) 2. Masonry (medium-heat type) ^d 3. Metal (smokestack) ^e	1. Masonry (high-heat type) 2. Metal (smokestack) ^e
TYPES OF APPLIANCES TO BE USED WITH EACH TYPE CHIMNEY			
Column I	Column II	Column III	Column IV
<p>A. Residential appliances, such as:</p> <ol style="list-style-type: none"> 1. Ranges 2. Warm-air furnaces 3. Water heaters 4. Hot water-heating boilers 5. Low-pressure steam heating boilers (not greater than 15 psig) 6. Domestic incinerators 7. Floor furnaces 8. Wall furnaces 9. Room heaters 10. Fireplace stoves <p>B. Fireplaces</p>	<p>A. All appliances shown in Column I</p> <p>B. Nonresidential-type building heating appliances for heating a total volume of space exceeding 25,000 cubic feet</p> <p>C. Appliances, such as:</p> <ol style="list-style-type: none"> 1. Annealing baths for hard glass (fats, paraffin, salts or metals) 2. Bake ovens (in bakeries) 3. Boiling vats, for wood fiber, straw, lignin, etc. 4. Candy furnace 5. Coffee roasting 6. Core ovens 7. Cruller furnaces 8. Feed frying ovens 9. Fertilizer drying 10. Fireplaces, other than residential type 11. Forge furnaces (solid fuel) 12. Gypsum kilns 13. Hardening furnaces (below dark red) 14. Hot-air engine furnaces 15. Ladle drying furnaces 16. Lead-melting furnaces 17. Nickel plate (drying) furnaces 18. Paraffin furnaces 19. Recuperative furnaces (spent materials) 20. Rendering furnaces 21. Rosin melting furnaces 22. Steam boilers operating at not greater than 50 psi; pressing machine boilers 	<p>A. All appliances shown in Columns I and II, and appliances, such as:</p> <ol style="list-style-type: none"> 1. Alabaster gypsum kilns 2. Annealing furnaces (glass or metal) 3. Charcoal furnaces 4. Cold-stirring furnaces 5. Feed driers (direct-fire-heated) 6. Fertilizer driers (direct-fire-heated) 7. Galvanizing furnaces 8. Gas producers 9. Hardening furnaces (cherry to pale red) 10. Incinerators, commercial- and industrial-type 11. Lehrs and glory holes 12. Lime kilns 13. Linseed oil-boiling furnaces 14. Porcelain briquet kilns 15. Pulp driers (direct-fire-heated) 16. Steam boilers operating at greater than 50 psig pressure, except pressing machine boilers 17. Water-glass kiln 18. Wood-distilling furnaces 19. Wood-gas retorts 	<p>A. All appliances shown in Columns I, II and III, and appliances^b, such as:</p> <ol style="list-style-type: none"> 1. Bessemer retorts 2. Billet and bloom furnaces 3. Blast furnaces 4. Bone calcining furnaces 5. Brass furnaces 6. Carbon-point furnaces 7. Cement brick and tile kilns 8. Ceramic kilns 9. Coal and water 10. Cupolas 11. Earthenware kilns 12. Glass-blow furnaces 13. Glass furnaces (smelting) 14. Glass kilns 15. Open-hearth furnaces 16. Ore-roasting furnaces 17. Porcelain baking and glazing kilns 18. Pot-arches 19. Puddling furnaces 20. Regenerative furnaces 21. Reverberatory furnaces 22. Stack, carburetor or super-heating furnaces (in water gas works) 23. Vitreous-enameling ovens (ferrous metals) 24. Wood-carbonizing furnaces

(continued)

TABLE 810—continued
CHIMNEY SELECTION CHART^c

CHIMNEYS FOR RESIDENTIAL-TYPE APPLIANCES	CHIMNEYS FOR LOW-HEAT APPLIANCES	CHIMNEYS FOR MEDIUM-HEAT APPLIANCES	CHIMNEYS FOR HIGH-HEAT APPLIANCES ^a
1. Factory-built (residential) ^{f, g} 2. Masonry (residential) ^d	1. Factory-built (low-heat) 2. Masonry (low-heat type) ^d 3. Metal (smokestack) ^e	1. Factory-built (medium-heat type) 2. Masonry (medium-heat type) ^d 3. Metal (smokestack) ^e	1. Masonry (high-heat type) 2. Metal (smokestack) ^e
TYPES OF APPLIANCES TO BE USED WITH EACH TYPE CHIMNEY			
Column I	Column II	Column III	Column IV
	23. Sterotype furnaces 24. Sulphur furnaces 25. Tripoli kilns (clay, coke and gypsum) 26. Type foundry furnaces 27. Unit heaters (oil-fired) 28. Wood-drying furnaces 29. Wood-impregnating furnaces 30. Zinc-amalgamating furnaces		

- a. Appliances otherwise classed as high-heat appliances may be considered as medium-heat appliances if not greater in size than 100 cubic feet.
b. When such appliances are greater in size than 100 cubic feet, and other furnaces are classified as high-heat appliances in accordance with nationally recognized good practice.
c. Continuous operating equipment of the counter-current type shall not require the type of flue indicated by general types of appliances.
d. For construction and other provisions for masonry chimney installation, see the *EPCOT Building Code*.
e. For construction and other provisions for metal chimney installation, see Sections 809 through 813.
f. Factory-built chimneys for use with closed-combustion, wood-burning appliances shall comply with the requirements of UL 103.
g. Nonresidential-type appliances for heating a total volume of space not to exceed 25,000 cubic feet may be connected to chimneys for residential-type appliances.

811.2.3 Roof penetrations. Where a metal chimney serving a medium-heat appliance, as defined in Table 810, passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of galvanized iron or approved corrosion-resistant metal, extending not less than 9 inches below and 9 inches above the roof construction, and of a size to provide not less than an 18-inch clearance on all sides of the chimney.

811.2.4 Wall clearance. Where a metal chimney used for medium-heat appliances, as defined in Table 810, is located in the same story of a building as that story in which the appliances connected are located, it shall have a clearance of not less than 36 inches from a wall of wood frame construction and from any combustible material.

811.3 Multiple-story installation.

811.3.1 Floor penetrations. Where a metal chimney extends through any story of a building above that story in which the appliances connected to the chimney are located, it shall be enclosed in such upper stories with walls of continuous, noncombustible construction, having a fire-resistance rating of not less than 1 hour.

811.3.2 Enclosure. The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair.

811.3.3 Openings. The enclosing walls shall be without openings, except doorways equipped with approved, self-closing fire doors at various floor levels for inspection purposes.

SECTION 812 METAL CHIMNEYS FOR HIGH-HEAT APPLIANCES

812.1 Construction. Metal chimneys used for high-heat appliances, as defined in Table 810, shall be lined with not less than 4½ inches of firebrick laid in fire-clay mortar, extending not less than 25 feet above the chimney connector entrance. Chimneys extending 25 feet or less above the chimney connector shall be lined to the top.

812.2 Termination. Metal chimneys for high-heat appliances shall extend not less than 20 feet higher than any portion of any building within 50 feet, and shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection, to permit maintenance operations on the chimney and to avoid the danger of burns to persons. Clearances shall be based on good engineering practice, and shall be approved by the Chief Mechanical Inspector.

SECTION 813 CHIMNEY CONNECTORS AND VENT CONNECTORS

813.1 Connectors required. Connectors shall be used to connect appliances to a vertical chimney or vent, unless the chimney or vent is attached directly to the appliance.

813.2 Limitations. Chimney connectors or vent connectors shall not connect to a chimney in an attic.

813.3 Materials.

813.3.1 Connector construction. Connectors shall be made of noncombustible material capable of withstanding the flue gas temperatures produced by the appliances and of sufficient thickness to withstand physical damage. The material of connectors shall also be resistant to corrosion. Connectors for appliances installed in attics shall be of Type B or L vent material for listed gas appliances with draft hoods, or of Type L vent material for oil appliances listed as suitable for Type L vents. For other appliances allowed in attics, a chimney shall be attached directly to the appliance.

813.3.2 Connector thickness. When selecting the thickness of metal for connectors of appliances not installed in attics, consideration should be given to factors such as location, maintenance, use, etc., as well as engineering design factors. See Table 813A for thicknesses of galvanized steel based on a given diameter connector.

TABLE 813A
MINIMUM THICKNESS OF GALVANIZED
STEEL BASED ON DIAMETER OF CONNECTOR

GALVANIZED THICKNESS (inch)	DIAMETER OF CONNECTOR (inches)
0.0276	Less than 10
0.0336	10 to 12
0.0396	14 to 16
0.0635	Greater than 16

813.3.3 Corrosion resistance. Connectors used for gas appliances having draft hoods, and for listed conversion burner-equipped appliances having draft hoods, shall be constructed of materials having resistance to corrosion and heat not less than that of 0.187-inch-thick steel, or they shall be of Type B or L vent material. Connectors made of Type L vent material shall be used with oil appliances listed as suitable for use with a Type L venting system.

813.4 Length. A connector shall be as short and straight as possible. The appliance shall be located as close as practical to the chimney, vent or venting system. The horizontal run of an uninsulated connector to a natural draft chimney or vent shall be not greater than 75 percent of the height of the vertical portion of the chimney or vent above the connector, unless part of an engineered venting system.

813.5 Size. The connector, for its entire length, shall not be less than the flue collar of the appliance, unless otherwise recommended by the appliance, chimney or vent manufacturer.

813.6 Clearance.

813.6.1 Chimney connectors. Clearance from combustible materials for chimney connectors shall be 18 inches for residential-type appliances, and commercial-industrial-type, low-heat appliances. The clearance for commercial-industrial-type, medium-heat appliances shall be 36 inches.

813.6.2 Vent connectors. Vent connector clearances for gas appliances not equipped with draft hoods, except clothes dryers, shall be 18 inches. This distance shall be 6 inches for listed gas appliances equipped with draft hoods, and for boilers and furnaces equipped with listed conversion

burners and with draft hoods. A vent connector of listed Type B or L venting material shall be used with listed appliances and shall be installed in accordance with their listing.

813.6.3 Direct-vent connectors. Vent connectors serving direct-vent appliances utilizing a condensing system shall be installed in accordance with the furnace manufacturer's installation instructions.

813.7 Location. When the connector used for a gas appliance having a draft hood must be located in or pass through a crawl space, or other cold area, that portion of the connector shall be of listed Type B or L vent material, or be provided with equivalent means of insulation.

813.8 Installation.

813.8.1 Connection. A connector to a masonry chimney shall extend through the wall to the inner face or liner but not beyond, and shall be firmly cemented to the masonry. A thimble shall be used to facilitate the removal of the chimney connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement.

813.8.2 Connector pass through. A chimney connector or vent connector shall not pass through any floor or ceiling.

813.8.3 Low-heat gas appliances. Connectors for listed low-heat gas appliances with draft hoods, except incinerators, shall pass through walls or partitions constructed of combustible material if:

- Made of listed Type B or L material, and installed with not less than listed clearances to combustible material.
- Made of single-wall metal pipe and guarded by a ventilated metal thimble not less than 4 inches greater in diameter than the vent connector.

813.8.4 Residential. Connectors for residential-type appliances, as defined in Table 810, passing through combustible walls or partitions shall be protected as required in Subsection 813.8.4.1, 813.8.4.2 or 813.8.4.3.

813.8.4.1 Connector pass through. The connector shall be listed for passing through combustible walls, and shall be installed according to the listing and the manufacturer's installation instructions.

813.8.4.2 Connector accessories. A connector accessory listed for passing connectors through combustible walls shall be used to carry the connector through the wall. The connector accessory shall be installed according to its listing and the manufacturer's installation instructions.

813.8.4.3 Connector limitations. The connector installation meets all of the following:

- The connector has a diameter not greater than 10 inches.
- Concealed metal parts of the pass-through system in contact with flue gases shall be of stainless steel or equivalent material that resists corrosion, softening or cracking of not less than 1,800°F.

CHIMNEYS AND VENTS

- (c) Insulation material used as a part of a wall pass-through shall be noncombustible and shall have a thermal conductivity of $1.0 \text{ Btu} \cdot \text{in}/\text{ft}^2 \cdot ^\circ\text{F}$ or less.
- (d) All clearances and thicknesses are minimums.
- (e) Materials used to close up openings for the connector shall be noncombustible.
- (f) Connectors for all systems, except System B, shall extend through the wall pass-through system to the inner face of the flue liner.
- (g) The connector is installed according to one of the systems shown in Figures 813A through 813D:

System A (12-inch clearance) A $3\frac{1}{2}$ -inch-thick wall shall be framed into the combustible wall as shown in this Figure. A $\frac{5}{8}$ -inch-thick fire-clay liner (ASTM C315 or equivalent) shall be firmly cemented in the center of the brick wall maintaining a 12-inch clearance to combustibles. The clay liner shall run from the outer surface of the bricks to the inner surface of the chimney liner, but it shall not protrude into the chimney liner.

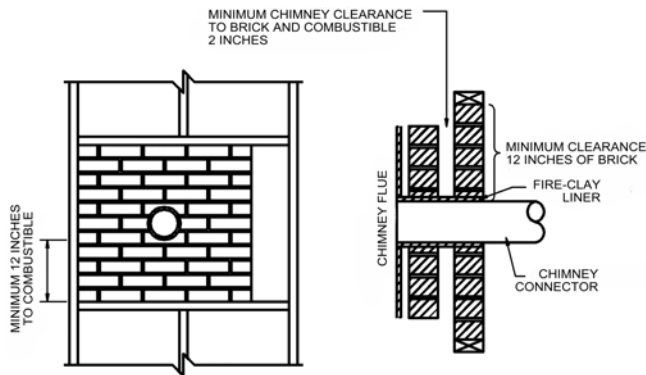


FIGURE 813A
CHIMNEY CONNECTOR—SYSTEM A

System B (9-inch clearance) A listed, solid-insulated factory-built chimney section (1-inch insulation), the same inside as the connector, shall be used as shown in this Figure. Sheet metal supports shall be positioned to maintain a 9-inch clearance to combustibles and the chimney section fasteners, and shall not penetrate the chimney section flue liner. The chimney length shall be flush with the masonry chimney liner and sealed to the masonry with water-insoluble, refractory cement. Chimney manufacturer's parts shall be used to securely fasten the chimney connector to the chimney section.

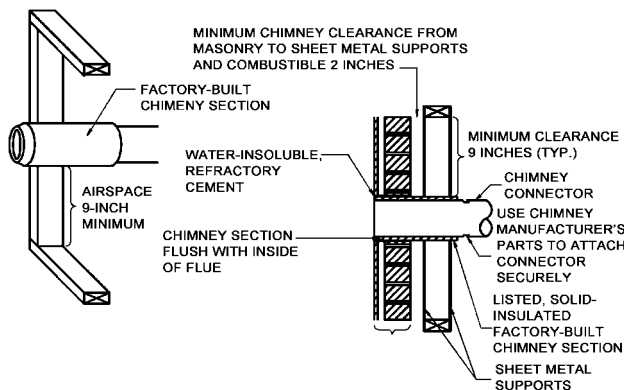


FIGURE 813B
CHIMNEY CONNECTOR—SYSTEM B

System C (6-inch clearance)

A sheet metal (minimum 24 gage) ventilated thimble having two, 1-inch air channels shall be used with a sheet steel chimney connector of 0.0239-inch-minimum thickness, as shown in this Figure. Sheet steel supports (minimum 24 gage) shall be cut to maintain a 6-inch clearance between the thimble and combustibles. The supports shall be fastened to the wall on all sides. Glass fiber insulation shall fill the 6-inch space between the thimble and supports. The thimble shall be secured to the support.

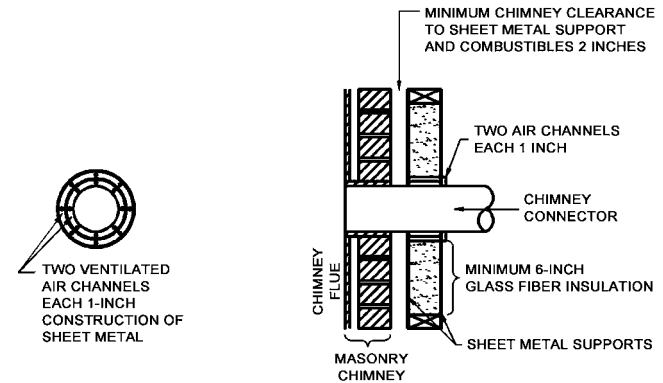


FIGURE 813C
CHIMNEY CONNECTOR—SYSTEM C

System D (2-inch clearance)

A listed, solid-insulated factory-built chimney section (1-inch insulation), with an inside diameter 2 inches greater than the chimney connector, shall be used with a sheet steel chimney connector of 0.0239-inch-minimum thickness, as shown in this Figure. Sheet metal supports shall be positioned to maintain a 2-inch clearance to combustibles, and to hold the chimney connector to ensure that a 1-inch airspace surrounds it as it passes through the chimney section. The sheet metal support shall be fastened to the wall on all sides and the chimney section shall be fastened to the supports. Fasteners used shall not penetrate the liner of the chimney section.

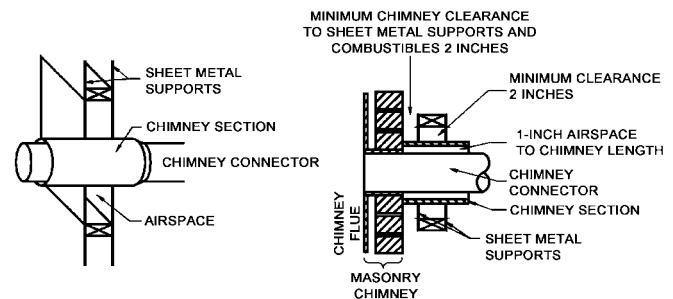


FIGURE 813D
CHIMNEY CONNECTOR—SYSTEM D

813.8.5 Low-heat appliances. Connectors of low-heat appliances, except listed residential-type and low-heat gas appliances with draft hoods (see Table 813B, Column 1), shall not pass through walls or partitions constructed of combustible material, unless they are guarded at the point of passage by:

- (a) Metal ventilated thimbles not less than 12 inches greater in diameter than the connector.
- (b) Metal or burned fire-clay thimbles built in brickwork or other approved fireproofing materials,

extending not less than 8 inches beyond all sides of the thimble.

813.8.6 Clearance. In lieu of thimbles, all combustible material in the wall or partition shall be cut away from the connector a sufficient distance to provide the clearance required from such connector. Any material used to close up such openings shall be noncombustible insulating material.

813.8.7 Combustible partitions. A connector of any medium- or high-heat appliance classified in Table 810 shall not pass through any wall or partition constructed of combustible material.

813.8.8 Slope. Connectors shall maintain a pitch of rise of not less than $\frac{1}{4}$ inch per foot (horizontal length of pipe) from the appliance to the chimney.

813.8.9 Obstructions. Connectors shall be installed so as to avoid sharp turns or other construction features that would create excessive resistance to the flow of flue gases. A device that will obstruct the free flow of flue gases shall not be installed in a connector chimney or vent. This shall not be construed to prohibit the use of devices specifically listed for installation in a connector, such as heat reclaimers, draft regulators and safety controls.

813.8.10 Support. Connectors shall be securely supported, and joints fastened with sheet metal screws, rivets or other approved means.

813.8.11 Access. The entire length of a connector shall be readily accessible for inspection, cleaning and replacement, unless listed materials are used and previous approval has been obtained from the Chief Mechanical Inspector.

813.8.12 Connection to fireplace. Connection of appliances to chimney flues serving fireplaces shall conform to the following:

- (a) **Closure and accessibility.** A noncombustible seal shall be provided below the point of connection to prevent the entry of room air into the flue. Means

shall be provided for access to the flue for inspection and cleaning.

- (b) **Connection to factory-built fireplace flue.** A different appliance shall not be connected to a flue serving a factory-built fireplace, unless the appliance is specifically listed for such installation. The connection shall be made in compliance with the appliance manufacturer's installation instructions.

- (c) **Connection to masonry fireplace flue.** A connector shall extend from the appliance to the flue serving a masonry fireplace such that the flue gases are exhausted directly into the flue. The connector shall be accessible or removable for inspection and cleaning of both the connector and the flue. Listed direct-connection devices shall be installed according to their listing.

813.9 Interconnection.

813.9.1 Power exhausters. Connectors shall not be connected to a chimney, vent or venting system served by a power exhauster, unless the connection is made on the negative pressure side of the exhauster.

Chimney connector systems and clearances from room wall combustibles for residential-type heating appliances shall comply with the following requirements:

- (a) Insulation material used as a part of a wall pass-through shall be noncombustible, and shall have a thermal conductivity of $1.0 \text{ Btu} \cdot \text{in}/\text{ft}^2 \cdot ^\circ\text{F}$ or less.
- (b) All clearances and thicknesses are minimums.
- (c) Materials used to close up openings for the connector shall be noncombustible.
- (d) Connectors for all systems, except System B (see Figure 813B), shall extend through the wall pass-through system to the inner face of the flue liner.

TABLE 813B
VENTING SYSTEM SELECTION CHART

TYPE OF VENTING SYSTEM			
Type B—Gas	Type BW—Gas	Type L—Oil	Metal pipe
(Round or Oval) A. All listed gas appliances/draft hoods, such as: 1. Central furnaces 2. Duct furnaces 3. Floor furnaces 4. Heating boilers 5. Ranges 6. Built-in oven 7. Vented wall furnaces listed for use with Type B vents 8. Room heaters 9. Water heaters 10. Horizontal furnaces 11. Unit heaters	A. Vertical wall furnaces for use with Type BW vents only	A. Low-temperatures flue appliance listed for use with Type L venting systems B. Gas appliances shown in Column I	A. Incinerators used outdoors, such as in open sheds, breezeways or carports, as provided in Subsection 904.16 B. Gas appliances shown in Column I C. Listed residential-type and low-heat gas appliances without draft hoods, and unlisted residential-type and low-heat gas appliances with or without draft hoods

813.9.2 Multiple connections. Two or more fuel-burning appliances may be connected to a single chimney or vent, provided sufficient draft is available for safe combustion in each appliance and removal of all the products of combustion safely to the outdoors. Gas and oil appliances so connected shall be equipped with primary safety controls.

813.10 Dampers.

813.10.1 Manual dampers. Manually operated dampers shall not be placed in chimneys, vents or connectors of stoker-fired, or liquid-or gas-burning appliances. Fixed baffles on the appliance side of draft hoods and draft regulators shall not be classified as dampers.

813.10.2 Automatic dampers. A listed automatic vent damper device shall be installed on an existing appliance installation, provided the appliance is listed and equipped with a draft hood and the device is installed by a qualified agency in accordance with the terms of its listing. The name of the installer and date of installation shall be marked on a label affixed to the damper device.

813.10.3 Fixed manual dampers. On gas appliances in excess of 800,000 Btu per hour input having more than two draft hoods, fixed manual baffles shall be used in the connectors between draft hoods and the common breeching as a means of equalizing the available draft pull.

813.11 Draft hoods. For information concerning the use and installation of draft hoods, refer to the *EPCOT Fuel Gas Code*.

SECTION 814 DRAFT REGULATORS

814.1 General. Gas appliances connected to chimneys, other than those required by the *EPCOT Fuel Gas Code* to be installed with draft hoods, shall be installed with draft regulators if in accordance with the appliance manufacturer's installation instructions.

814.2 Use and installation. For information concerning the use and installation of draft regulators with oil-burning appliances, refer to NFPA 31.

814.3 Solid fuel-burning appliances. Solid fuel-burning appliances shall be installed with draft regulators to reduce draft intensity. Such regulators shall be installed and set in accordance with the instructions furnished with the appliance or the draft regulator.

814.4 Barometric draft regulation. A barometric draft regulator, if used, shall be installed in the same room or enclosure as the appliance in such a manner that a difference in pressure between the air in the vicinity of the regulator and the combustion air supply will not be permitted.

SECTION 815 DIRECT-VENT, INTEGRAL VENT, MECHANICAL VENT AND VENTILATION/EXHAUST HOOD VENTING

815.1 Direct-vent terminations. Vent terminals for direct-vent appliances shall be installed in accordance with the manufacturer's installation instructions.

815.2 Appliances with integral vents. Appliances incorporating integral venting means shall be installed in accordance with their listings and the manufacturer's installation instructions.

815.2.1 Terminal clearances. Appliances designed for natural draft venting, and incorporating integral venting means, shall be located so that the minimum clearance of 9 inches is maintained between vent terminals and from any opening through which combustion products enter the building. Appliances using forced draft venting shall be located so that a minimum clearance of 12 inches is maintained between vent terminals and from any openings through which combustion products enter the building.

815.3 Mechanical draft system. Mechanical draft systems of either forced draft or induced draft design shall comply with Subsections 815.3.1 through 815.3.7.

815.3.1 Forced draft systems. Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to be gas tight to prevent the leakage of combustion products into the building.

815.3.2 Automatic shutoff. Power exhausters shall be electrically connected to each appliance to prevent the operation of the appliance when the power exhauster is not in operation.

815.3.3 Termination. The termination of chimneys or vents equipped with power exhausters shall be located a minimum of 10 feet from the lot line or from adjacent buildings. The exhaust shall be directed away from the building.

815.3.4 Horizontal terminations. Horizontal terminations shall comply with the following requirements:

- (a) Where located adjacent to walkways, the termination of mechanical draft systems shall not be less than 7 feet above the level of the walkway.
- (b) Vents shall terminate a minimum of 3 feet above any forced-air inlet located within 10 feet.
- (c) The vent system shall terminate a minimum of 4 feet below, 4 feet horizontally from or 1 foot above any door, window or gravity-air inlet into the building.
- (d) The vent termination point shall be not located closer than 3 feet to an interior corner formed by two walls perpendicular to each other.
- (e) The vent termination shall not be mounted directly above or within 3 feet horizontally from an oil tank vent or gas meter.
- (f) The bottom of the vent termination shall be located a minimum of 12 inches above finished grade

815.3.5 Vertical terminations. Vertical terminations shall comply with the following requirements:

- (a) Where located adjacent to walkways, the termination of mechanical draft systems shall be not less than 7 feet above the level of the walkway.
- (b) Vents shall terminate a minimum of 3 feet above any forced-air inlet located within 10 feet.

- (c) Where the vent termination is located below an adjacent roof structure, the termination point shall be located a minimum of 3 feet from such structure.
- (d) The vent shall terminate a minimum of 4 feet below, 4 feet horizontally from or 1 foot above any door, window or gravity-air inlet for the building.
- (e) A vent cap shall be installed to prevent rain from entering the vent system.
- (f) The vent termination shall be located a minimum of 3 feet horizontally from any portion of the roof structure.

815.3.6 Exhauster connections. An appliance vented by natural draft shall not be connected into a vent, chimney or vent connector on the discharge side of a mechanical flue exhauster.

815.3.7 Exhauster sizing. Mechanical flue exhausters and the vent system served shall be sized and installed in accordance with the manufacturer's installation instructions.

CHAPTER 9

SPECIAL FUEL-BURNING EQUIPMENT

SECTION 901 GENERAL

901.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of special fuel-burning equipment.

SECTION 902 FACTORY-BUILT WOOD- AND COAL-BURNING STOVES

902.1 Listing. Factory-built wood- and coal-burning stoves that are listed by a nationally recognized testing laboratory shall be installed in accordance with the listing.

902.2 Wall and ceiling clearances. Factory-built wood- and coal-burning stoves that have not been tested and listed shall be installed with the clearances specified in Table 304.

902.3 Floor protection. Combustible floors under unlisted coal- and wood-burning stoves shall be protected in accordance with the following:

- (a) Stoves without legs, or with legs providing an airspace less than 4 inches between the ash box or bottom of the firing chamber and combustible floor, shall have the combustible floor protected with sheet metal that shall be covered with two courses of 4-inch hollow tile or its equivalent, this in turn covered with a minimum of $\frac{3}{16}$ -inch metal. Three courses of brick with the top course laid on edge, providing ventilating space between them, may be used in lieu of the two courses of 4-inch tile. The floor protection shall extend 12 inches beyond the sides and rear, and 24 inches beyond the front of the stove.
- (b) Stoves equipped with legs providing an airspace of 4 inches to 17 inches between the ash box or bottom of the firing chamber and combustible floor shall have the floor protected with sheet metal, which shall be covered with 4-inch hollow tile or its equivalent. The protection shall extend a minimum of 12 inches beyond the sides and rear, and 24 inches beyond the front of the stove.
- (c) Stoves equipped with legs providing an airspace of 18 inches or more between the ash box or bottom of the firing chamber and combustible floor shall have the floor protected with a minimum of 28-gage metal extending 12 inches beyond the sides and 24 inches beyond the front of the stove.

902.4 Connection to fireplace. Connection of solid fuel appliances to chimney flues serving fireplaces shall comply with Subsections 801.8 and 813.8.12.

SECTION 903 FIREPLACES

903.1 Factory-built fireplaces. Factory-built fireplaces shall be listed, and shall be installed in accordance with the condi-

tions of the listing. Factory-built fireplaces also shall be required to be installed in accordance with Subsections 903.3.6 and 903.3.9. The factory-built fireplaces shall be tested in accordance with and meet the requirements of UL 127.

903.2 Factory-built fireplace stoves. Factory-built fireplace stoves and solid fuel-type room heaters shall be listed, and shall be installed in accordance with the conditions of the listing. The factory-built fireplace stoves shall be tested in accordance with and meet the requirements of UL 737. The solid fuel-type room heaters shall be tested in accordance with and meet the requirements of UL 1482.

903.3 Masonry fireplaces.

903.3.1 Dimensions. Fireplaces shall be constructed of solid masonry or reinforced concrete, with the back and sides of the thickness specified in this Subsection, except as provided in Subsection 903.1. Where a lining of firebrick a minimum of 2 inches thick or other approved lining is provided, the total thickness of the back and sides, including the lining, shall be not less than 8 inches of solid masonry or reinforced concrete. Where no such lining is provided, the thickness of the back and sides shall be not less than 12 inches of solid masonry or reinforced concrete.

903.3.2 Firebox liners. Steel fireplace units incorporating a firebox liner of not less than $\frac{1}{4}$ -inch-thick steel and an air chamber shall be installed with masonry to provide a total thickness at the back and sides of not less than 8 inches, not less than 4 inches of which shall be solid masonry.

903.3.3 Warm-air ducts. Warm-air ducts employed with steel fireplace units of circulating-air types shall be constructed of metal or masonry.

903.3.4 Hearths. Fireplace hearth extensions shall be provided of approved, noncombustible material for all fireplaces. Where the fireplace opening is a minimum of 6 square feet, the hearth extension shall extend a minimum of 16 inches in front of the facing material and a minimum of 8 inches beyond each side of the fireplace opening. Where the fireplace opening is 6 square feet or greater, the hearth extension shall extend a minimum of 20 inches in front of the facing material and a minimum of 12 inches beyond each side of the fireplace opening. Where a fireplace is elevated above or overhangs a floor, the hearth extension shall also extend over the area under the fireplace.

903.3.5 Noncombustible materials. Fireplaces constructed of masonry or reinforced concrete shall have hearth extensions of brick, concrete, stone, tile or other approved noncombustible material properly supported and with no combustible material against the underside thereof. Wooden forms or centers used during the construction of the hearth and hearth extension shall be removed when the construction is completed.

903.3.6 Factory-built fireplaces and stoves. Hearth extensions of approved factory-built fireplaces and fireplace stoves shall be installed in accordance with the *EPCOT Building Code*.

903.3.7 Separation from wood. All wood beams, joists and studs shall be trimmed away from fireplaces. Headers supporting trimmer arches at fireplaces shall be not less than 20 inches from the face of the chimney breast. Trimmers shall be not less than 6 inches from the inside face of the nearest flue lining.

903.3.8 Backside clearance. Woodwork shall not be placed within 4 inches of the back of a fireplace, but this shall not prevent plastering directly on the masonry, or on metal lath and metal furring.

903.3.9 Mantles and trim. Woodwork shall not be placed within 6 inches of a fireplace opening. Woodwork above and projecting greater than 1½ inches from a fireplace opening shall not be placed less than 12 inches from the top of a fireplace opening.

903.4 False fireplaces. False fireplaces may be used in connection with listed gas or electric heaters, provided such fireplaces are constructed of noncombustible materials.

SECTION 904 INCINERATORS

904.1 General. The application of this Section is intended to regulate and control the design, construction, quality of material, use, location and maintenance of all incinerators. Installation and alteration of incinerators shall be governed by all applicable provisions of this Code.

904.2 Approved standards. Construction and installation of equipment and appurtenances complying with NFPA 82, and not in conflict with this Code, will be approved.

904.3 Controlled air package units. Equipment designed and constructed as controlled air packaged units that results in stack emissions acceptable to the Environmental Protection Agency, or state or local governing agencies, will be approved for installation and operation under this Code.

904.4 Alternative materials and methods. In existing buildings or premises in which incinerator installations are to be altered, repaired or renovated, the Chief Mechanical Inspector may permit deviations from the provisions of this Code, provided that such deviations are in keeping with the intent of this Code to protect the health, safety and welfare of the occupant of such premises and the general public.

904.5 Locations.

904.5.1 Commercial and industrial. All commercial and industrial incinerators installed indoors shall be located in rooms separated from the rest of the building by a minimum of 1-hour fire-resistant construction. More restrictive requirements may be required due to occupancy or building type classification, which may be determined by reference to the *EPCOT Building Code*.

904.5.2 One- and two-family. In one- and two-family dwellings, residential-type incinerators need not be in a separate room.

904.5.3 Outdoor location. Outdoor installation of incinerators shall be so located as not to introduce any direct exposure to adjacent buildings, structures or outside permanent storage areas of combustible material while the incinerator is in operation.

904.6 Classification of incinerators. Incinerators shall be classified as follows:

- (a) **Class I.** Portable, packaged, completely assembled, direct-fed incinerators, having not greater than 5 cubic feet of storage capacity or a 25-pound-per-hour burning rate, suitable for Type 2 waste.
- (b) **Class IA.** Portable, packaged or job-assembled, direct-fed incinerators with 5 cubic feet to 15 cubic feet primary chamber volume; or a burning rate of 25 pounds per hour up to, but not including 100 pounds per hour of Type 0, 1 or 2 waste; or a burning rate of 25 pounds per hour up to, but not including 75 pounds per hour of Type 3 waste.
- (c) **Class II.** Fuel-fed, single-chamber incinerators with greater than 2 square feet of burning area, suitable for Type 2 waste. This type of incinerator is served by one vertical flue, functioning both as a chute for charging waste and to carry the products of combustion to atmosphere. This type of incinerator is installed in apartment houses or multiple dwellings not more than five stories high. This type of incinerator is prohibited.
- (d) **Class IIA.** Chute-fed, multiple-chamber incinerators, with more than 2 square feet of burning area, suitable for Type 1 or 2 waste. (Not recommended for industrial wastes.) This type of incinerator is served by a vertical chute for charging wastes from two or more floors above the incinerator and a separate flue for carrying the products of combustion to atmosphere.
- (e) **Class III.** Direct-fed incinerators with a burning rate of 100 pounds per hour and more, suitable for Type 0, 1 or 2 waste.
- (f) **Class IV.** Direct-fed incinerators with a burning rate of 75 pounds per hour or more, suitable for Type 3 waste.
- (g) **Class V.** Municipal incinerators suitable for Type 0, 1, 2 or 3 waste, or a combination of all four wastes, rated in tons per hour or tons per 24 hours.
- (h) **Class VI.** Crematory and pathological incinerators, suitable for Type 4 waste.
- (i) **Class VII.** Incinerators designed for specific byproduct wastes, suitable for Type 5 or 6 waste.

904.7 Classification of waste. Classification of waste shall be as follows:

- (a) **Type 0.** Trash, a mixture of highly combustible waste, such as paper, cardboard, cartons, wood boxes, and combustible floor sweepings, from commercial and industrial activities. The mixtures contain not greater than 10 percent by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags, and plastic or rubber scraps.
- (b) **Type 1.** Rubbish, a mixture of combustible waste, such as paper, cardboard cartons, wood scrap, foliage and combustible floor sweepings, from domestic,

commercial and industrial activities. The mixture contains not greater than 20 percent by weight of restaurant or cafeteria waste, but contains little or no treated plastic or rubber wastes.

- (c) **Type 2.** Refuse, consisting of an approximately even mixture of rubbish and garbage by weight. This type of waste is common to apartment and residential occupancies, consisting of not greater than 50 percent moisture and 7 percent noncombustible solids, and has a heating value of 4,300 Btu per pound (Btu/lb) as fired.
- (d) **Type 3.** Garbage, consisting of animal and vegetable wastes from restaurants, cafeterias, hotels, hospitals, markets and like installations. This type of waste contains not greater than 7 percent moisture and not greater than 5 percent noncombustible solids, and has a heating value of 2,500 Btu/lb as fired.
- (e) **Type 4.** Human and animal remains, consisting of carcasses, organs and solid organic wastes from hospitals, laboratories, abattoirs, animal pounds and similar sources, consisting of not greater than 85 percent moisture and 5 percent noncombustible solids, and having a heating value of 1,000 Btu/lb as fired.
- (f) **Type 5.** Byproduct waste, gaseous, liquid or semiliquid, such as tar, paints, solvents, sludge, fumes, etc., from industrial operations. Btu values must be determined by the individual materials to be destroyed.
- (g) **Type 6.** Solid byproduct waste, such as rubber, plastics, wood waste, etc., from industrial operations. Btu values must be determined by the individual materials to be destroyed.

904.8 Gas-fired incinerators.

904.8.1 Installation. Listed gas-fired incinerators shall be installed as close as practicable to a vent and with a minimum of 12 inches of clearance between the sides and combustible construction, except that appliances approved for installation at lesser clearances shall be installed in accordance with their listing. In no case shall the clearance be such as to interfere with the requirements for combustion air and accessibility. Incinerators of the wall type shall be installed in a noncombustible wall communicating directly with a chimney flue.

904.8.2 Connecting draft hoods. A draft hood shall not be connected into a flue pipe of an incinerator. Where conditions permit, it is preferable to have the flue pipe connected to a separate chimney flue.

904.8.3 Flue pipes.

904.8.3.1 Clearance. Flue pipes shall have a minimum of 18 inches of clearance from combustible construction and shall not pass through combustible construction unless guarded at the point of passage.

904.8.3.2 Material. The flue pipe from an incinerator to a vent shall be of galvanized steel a minimum of 0.0276 inch thick, or of material having equivalent or superior heat and corrosion-resistant properties. Joints shall be secured by sheet metal screws.

904.8.4 Pilot devices. Automatic pilot devices having a response time of not greater than 5 seconds shall be

installed on all gas burners in unlisted commercial incinerators installed in buildings.

904.9 Gas burners.

904.9.1 Less than 400,000 btu/h. Gas burner equipment operating at 400,000 Btu per hour (Btu/h) or less shall be of either the atmospheric- or power-burner type. In either case, a continuous burning or intermittent stable pilot adequate to ensure a safe, reliable ignition shall be installed. A flame safeguard shall be used so that no gas can flow to the main burner unless satisfactory ignition is assured. The response time of this flame safeguard to de-energize the gas shutoff device on flame failure shall not exceed 2 seconds to 4 seconds.

904.9.2 Greater than 400,000 btu/h. At inputs of 400,000 Btu/h or greater, the burner equipment shall be of the power type that utilizes a forced draft blower to supply air needed for combustion under controlled conditions. A continuous burning or intermittent pilot shall be used to ensure safe and reliable ignition. Automatic spark ignition shall be used on pilots for burners with input greater than 1,000,000 Btu/h. A suitable flame safeguard shall be utilized so that no gas can flow to the main burner unless satisfactory ignition is ensured. On burners with inputs from 400,000 Btu/h to 1,000,000 Btu/h, the response time of the flame safeguard to de-energize the gas shutoff device on flame failure shall not exceed 5 seconds. In capacities greater than 1,000,000 Btu/h, the response time of the aforementioned flame safeguard shall be not more than 4 seconds.

904.9.3 Burner assembly. The burner assembly shall consist of the main burner, pilot burner, automatic valve, the necessary manual valves and accessory equipment, in addition to interconnecting pipes and fittings with provisions for rigid mounting. The burner shall be constructed so that parts cannot be incorrectly located or incorrectly fitted together. When sealed to incinerator walls, power burners with capacities greater than 100,000 Btu/h shall be supplied with a means of providing air supply before the main gas valve can be energized.

904.9.4 Electric motors. Electrical motors with more than $\frac{1}{12}$ horsepower on power burner equipment shall be designed for continuous duty, and shall be provided with thermal overload protection, or current-sensitive devices.

904.9.5 Complete shutoff system. When a complete automatic pilot shutoff system is utilized, the controls shall be readily accessible and arranged so that the main burner gas can be manually shut off during the lighting of pilot. When a complete automatic system is not utilized, a readily accessible, manually operated, quarter-turn lever handle, plug-type valve shall be provided to shut off or turn on the gas supply to the main burner manifold. This valve shall be upstream from all controls, except the pilot control valve.

904.9.6 Additional requirements. For additional gas requirements, see the *EPCOT Fuel Gas Code*.

904.10 Scrubber or gas washer.

904.10.1 Dust emissions. The total dust emissions from the flue gas scrubber shall be not greater than 0.4 pound dry

dust per 1,000 pounds flue gas, corrected to 50 percent excess air.

904.10.2 Internal volume. The scrubber may be separate from or an integral part of the incinerator, but no internal volume of the scrubber shall be included as a part of the incinerator internal volume.

904.10.3 Linings. Lined scrubbers shall have a welded or gasketed casing of not less than 0.1046-inch steel. The density of the refractory lining shall be not less than 120 pounds per cubic foot. The thickness of the refractory shall in no case be less than 2 inches and adequately anchored to the casing.

904.10.4 Draft fans. All scrubbers requiring an induced draft fan shall have the motor horsepower sized for cold start-up. All induced draft fans with the impeller in the flue gas stream must be equipped with a cleanout door and drain. The induced draft fan, if provided, shall be interlocked with the sprays.

904.10.5 Access doors. All scrubbers shall be equipped with an access door for cleanout.

904.10.6 Dampers. A damper shall be located either between the incinerator and scrubber, or at the inlet of the induced draft fan, with a bypass arrangement of breechings or flue connections to bypass the scrubber and induced draft fan.

904.11 Stacks and chimneys. Masonry chimneys for commercial- and industrial-type incinerators shall be designed and constructed in accordance with the requirements of Subsection 904.15. Metal stacks shall be designed and constructed as specified in Subsection 904.16.

904.12 Spark arresters. All chimneys and stacks shall terminate in a spark arrester. Spark arresters shall be constructed of Series 300 stainless steel wire of not less than a 0.063-inch diameter. Wire shall be woven in a mesh with wire spacing of not less than three equal spaces per inch.

904.13 Marking incinerators. A nameplate shall be conspicuously fastened to the incinerator indicating the manufacturer's name, model number, rated capacity of the unit, classification and the type of waste for which the incinerator is designed.

904.14 Operation of incinerators. The incinerator operator shall follow the written operating instructions of the manufacturer. A copy of these instructions shall be submitted for approval to the Chief Mechanical Inspector at the time of application of the permit.

904.15 Masonry chimneys for incinerators.

904.15.1 Residential type. Masonry chimneys for residential-type incinerators shall be constructed in accordance with Section 805.

904.15.2 Fuel-fed apartment type. The flue of fuel-fed incinerators (apartment-house type) shall serve the incinerator only and be used for no other purpose. The flue liner shall be straight and plumb, and shall be smooth on the inside, and the size of incinerator flues shall be in accordance with the following:

- (a) Where not greater than one service opening is provided, the size of the flue shall be not less than 14 inches by 14 inches or 196 square inches, inside measurements, except that in one-family dwellings, the size shall be not less than 12 inches by 12 inches or 144 square inches.
- (b) Where two to six service openings are provided, the size of the flue shall be not less than 18 inches by 18 inches or 324 square inches, inside measurements.
- (c) Where seven or more service openings are provided, the size of the flue shall be not less than 22 inches by 22 inches or 484 square inches, inside measurements.

904.15.3 Small combustion chambers. A masonry chimney serving an incinerator with a combustion chamber having a horizontal combined hearth and grate area of 7 square feet or less shall have walls of clay or shale brickwork not less than 4 inches thick, with a lining of 4½ inches of firebrick for a distance of not less than 10 feet above the roof of the combustion chamber. Beyond this point, chimney walls shall consist of not less than 8 inches of clay or shale brickwork, with a standard fire-clay tile flue liner not less than 5⁄8 inch thick extending from the top of the firebrick lining to the top of the chimney.

904.15.4 Large combustion chambers. A masonry chimney serving an incinerator with a combustion chamber having a horizontal combined hearth and grate area exceeding 7 square feet shall have walls of clay or shale brickwork not less than 4 inches thick, with a lining of 4½ inches of firebrick for a distance of not less than 40 feet above the roof of the combustion chamber. Beyond this point, chimney walls shall consist of not less than 8 inches of clay or shale brickwork with a standard fire-clay tile flue liner not less than 5⁄8 inch thick extending from the top of the firebrick lining to the top of the chimney.

904.15.5 Equivalent construction. Other constructions may be used if equivalent to the construction outlined in Subsections 904.15.1 through 904.15.4 in structural strength, insulating value, and the ability to withstand thermal expansion and flame impingement.

904.15.6 Firebrick. Firebrick shall be laid in high-temperature cement or fire-clay mortar.

904.15.7 Two-channel flues. A chimney flue that is divided into two channels, one for feeding refuse and the other for the discharge of combustion gases, shall be constructed as specified in Subsection 904.15.

904.15.8 Chimney support. Masonry chimneys for fuel-fed incinerators shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire-resistance rating of not less than 3 hours may be used to support masonry chimneys where such supports are independent of the floor construction and the load is transferred to the ground. They shall be so constructed as not to place excessive stress upon the roof of the combustion chamber. Masonry chimneys shall be supported on incinerator walls.

904.15.9 Spark arrester. All flues shall terminate in a substantially constructed spark arrester with openings not

greater than $\frac{3}{4}$ inch, or be provided with other suitable means of avoiding the discharge of flying particles. Expansion chambers used as a secondary combustion chamber shall be constructed equivalent to that of the incinerator combustion chamber. Those used only for settling shall be of construction equivalent to that of the upper portion of the incinerator.

904.15.10 Chimney height. Masonry chimneys of fuel-fed incinerators shall extend a minimum of 4 feet above sloping roofs measured from the highest point at which the chimney passes through the roof and a minimum of 8 feet above flat roofs. In either case, the chimney shall extend a minimum of 2 feet higher than any portion of a building within 20 feet.

904.15.10.1 Chimney clearance. A clearance of not less than 2 inches shall be provided between the exterior surface of chimneys for fuel-fed apartment-house-type incinerators and combustible material.

904.15.10.2 Combustible lathing or furring. Combustible lathing, furring or plaster grounds shall not be placed against a chimney at any point more than $1\frac{1}{2}$ inches from the corner of the chimney, but this shall not prevent plastering directly on the masonry, or on metal lath and metal furring; nor shall it prevent placing chimneys entirely on the exterior of a building against the sheathing.

904.15.11 Hopper. All service openings into an incinerator flue shall be provided with a hopper or other charging device constructed of metal of sufficient thickness and durability to prevent cracking, breakage or deformation in normal usage. Such hopper or other charging device shall be firmly built into the masonry, and shall be so designed and installed that no part will project into the flue and that the opening to the flue exterior will be closed off while the service opening (hopper) door is fully open. The hopper or other device shall be counterweighted or otherwise devised so that it will close automatically upon release and be so constructed as to be tight fitting when in the closed position.

904.15.12 Commercial and industrial chimneys. Masonry chimneys of commercial- and industrial-type incinerators, except as provided in Subsections 904.15.13 and 904.15.14, shall be not less than 8 inches of clay or shale brickwork, or reinforced concrete, lined with firebrick not less than $4\frac{1}{2}$ inches thick for the full height of the chimney.

904.15.13 Low flue-gas allowances. Subject to the approval of the Chief Mechanical Inspector, commercial- and industrial-type incinerators shall be connected to chimneys constructed of 8 inches of clay or shale brickwork, or reinforced concrete lined with a fire-clay flue liner, where the incinerator is specially constructed to produce low flue-gas temperatures.

904.15.14 Equivalent construction. Other constructions may be used if equivalent to Subsections 904.15.12 and 904.15.13 in structural strength, insulating value, and the ability to withstand thermal expansion and flame impingement.

904.15.15 High-temperature cement. Firebrick and other refractory lining shall be laid in high-temperature cement or fire-clay mortar.

904.15.16 Footings and foundations. Masonry chimneys for commercial- and industrial-type incinerators shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire-resistance rating of not less than 3 hours may be used to support masonry chimneys where such supports are independent of the floor construction and the load is transferred to the ground. They shall be so constructed as not to place excessive stress upon the roof of the combustion chamber. Masonry chimneys may be supported on incinerator walls.

904.15.17 Spark arresters. Incinerators used for the burning of rubbish or other readily combustible solid waste material shall include effective means for arresting sparks and flying particles, such as an expansion chamber, baffle walls or other effective arrangement, or the flues of such incinerators shall be provided with an approved spark arrester having openings not greater than $\frac{1}{2}$ inch.

904.15.18 Chimney height for commercial and industrial. Masonry chimneys for commercial- and industrial-type incinerators shall extend a minimum of 4 feet above sloping roofs measured from the highest point at which the chimney passes through the roof and a minimum of 8 feet above flat roofs. In either case, the chimney shall extend a minimum of 2 feet above any ridge, parapet, cornice, penthouse or other obstruction within 20 feet.

904.15.19 Clearance to combustibles. A clearance of not less than 4 inches shall be provided between the exterior surface of masonry chimneys for commercial- and industrial-type incinerators and combustible material.

904.16 Metal chimneys for incinerators.

904.16.1 Materials. Metal pipe made from 0.0396-inch-minimum galvanized steel or other equivalent noncombustible corrosion-resistant material shall be used for residential-type incinerators installed in locations such as sheds, breezeways or carports, provided the metal pipe is exposed and readily examinable for its full length and clearances not less than 18 inches are maintained from combustible material. The metal pipe shall extend a minimum of 3 feet above the highest point where it passes through the roof and a minimum of 2 feet higher than any portion of the building within 10 feet. Where the metal pipe passes through a roof constructed of combustible material, clearances shall conform to the requirements of Subsection 810.2.

904.16.2 Linings. Metal chimneys of commercial- and industrial-type incinerators shall be lined with firebrick not less than $4\frac{1}{2}$ inches thick for the full height of the chimney.

904.16.3 Firebrick. Firebrick shall be laid in high-temperature cement or fire-clay mortar.

904.16.4 Low flue-gas temperatures. Subject to the approval of the authority having jurisdiction, commercial- and industrial-type incinerators may be connected to a metal chimney without a firebrick flue liner, provided the

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incinerator is specially constructed to produce low flue-gas temperatures.

904.16.5 Chimney heights. Metal chimneys of commercial- and industrial-type incinerators shall extend a minimum of 4 feet above sloping roofs measured from the highest point at which the metal chimney passes through the roof and a minimum of 8 feet above flat roofs. In either case, the chimney shall extend a minimum of 2 feet higher than any portion of a building within 20 feet.

904.16.6 Clearance to combustibles. A clearance of not less than 4 inches shall be provided between the exterior surface of metal chimneys for commercial- and industrial-type incinerators and combustible material.

CHAPTER 10

BOILER/WATER HEATERS

SECTION 1001 GENERAL

1001.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of boilers and water heaters.

1001.2 Standards. All boilers shall be designed and constructed in accordance with the requirements of one of the following standards:

- (a) ANSI Z21.13, *Gas-Fired, Low-Pressure Steam and Hot Water Boilers*.
- (b) ANSI Z21.59, *Gas-Fired, High-Pressure Steam and Hot Water Boilers*.
- (c) ASME *Boiler and Pressure Vessel Code*, Sections I, IV and IX.

1001.3 Water heaters and hot water storage tanks. Water heaters and hot water storage tanks shall be fabricated and installed in accordance with Chapter 5 of the *EPCOT Plumbing Code*.

SECTION 1002 OPERATING AND SAFETY CONTROLS

1002.1 General. Automatic boilers shall be equipped with controls and limit devices as set forth in Table 1002. Automatic boilers also shall be equipped with the following gages, as applicable: oil temperature, oil suction pressure, high- and low-gas pressure, stack temperature and windbox pressure. Except as otherwise specified, gas-fired boilers exceeding 400,000 Btu per hour (Btu/h) input shall conform to nationally recognized standards approved by the Chief Mechanical Inspector. The Chief Mechanical Inspector shall approve solid fuel-fired boilers that can meet the safety requirements for automatic gas- or oil-fired boilers.

1002.2 Shutoff valve. An approved manual shutoff valve shall be installed upstream of all control devices on the main burner of a gas-fired boiler. The takeoff point for the gas supply to the pilot shall be upstream of the gas shutoff valve of the main burner and shall be valved separately. A union or other approved means of disconnect shall be provided immediately downstream of these shutoff valves.

1002.3 Safety devices. Every boiler and pressure vessel shall be provided with a safety or relief valve to ensure positive relief of any pressure greater than the pressure rating of the system. Each such valve shall be placed on the boiler side of all other valves and accessories, and shall be mounted vertically on top of the boiler shell, and shall be of sufficient capacity to relieve the Btu energy that can be supplied to the

boiler or as otherwise approved by the Chief Mechanical Inspector. Valves so employed shall be of such nature, and so constructed and arranged, as to permit their being tested manually to determine their operating condition.

1002.4 Relief valve discharge. The discharge from relief valves shall be piped to within 18 inches of the floor or to an open receptacle, and when the operating temperature is in excess of 212°F, shall be equipped with a splash shield or centrifugal separator. When the discharge from safety valves would result in a hazardous discharge of steam inside the boiler room, such discharge shall be extended outside the boiler room. No valve of any description shall be placed between the safety or relief valve and the boiler, nor on the discharge pipe between the safety valve and the atmosphere. The discharge pipe shall be supported so that no undue stress is placed on the valve body.

SECTION 1003 LOW-WATER CUTOFFS

1003.1 General. Each automatically fired steam boiler shall be fitted with a low-water fuel cutoff so located as to automatically cut off the fuel supply when the surface of the water falls to the lowest safe waterline, which shall be not lower than the lowest visible part of the gage glass. If a water feeder is installed, it shall be so constructed that the water inlet valve cannot feed water into the boiler through the float chamber and so located as to supply the requisite feed water. The use of internal-type, low-water cutoff valves is prohibited.

1003.2 Location. All fuel-fired water heating boilers shall be provided with an externally mounted, low-water cutoff or control. The use of an internal low-water cutoff is permitted, provided the device is of the approved type and the installation is in compliance with the ASME *Boiler and Pressure Vessel Code*.

SECTION 1004 ACCESSIBILITY

1004.1 Working clearance. Clearances shall be maintained around all boilers, generators, heaters, tanks and all other equipment so as to permit inspection, servicing, repair or replacement, and normal visibility of all gages.

TABLE 1002
CONTROLS AND LIMIT DEVICES FOR AUTOMATIC BOILERS

BOILER GROUP	FUEL	FUEL INPUT RANGE (INCLUSIVE) ^a (Btu/h)	TYPE OF PILOT ^b	SAFETY CONTROL TIMING (nominal maximum time in seconds)				ASSURED FUEL SUPPLY CONTROL ^d	ASSURED AIR SUPPLY CONTROL ^e	LOW-FIRE START UP CONTROL ^f	PRE-PURGING CONTROL ^g	HOT WATER TEMPERATURE AND LOW-WATER LIMIT CONTROLS ^h	STEAM PRESSURE AND LOW-WATER LIMIT CONTROLS ⁱ	APPROVED FUEL SHUTOFF ^j	CONTROL AND LIMIT-DEVICE SYSTEM DESIGN ^k
				Trial for pilot	Trail for main burner flame		Main burner flame failure ^c								
					Direct electric ignition	Flame pilot									
A	Gas	0 – 400,000	Any type	90	Not required	90	90	Not required	Required	Not required	Not required	Required	Required	Not required	Required
B	Gas	400,001 – 2,500,000	Interrupted or intermittent	15	15	15	2 – 4	Not required	Required	Not required	Not required	Required	Required	Not required	Required
C	Gas	2,500,001 – 5,000,000	Interrupted or intermittent	15	15	15	2 – 4	Required	Required	Required	Required	Required	Required	Required	Required
D	Gas	Greater than 5,000,000	Interrupted	15	15	15	2 – 4	Required	Required	Required	Required	Required	Required	Required	Required
E	Oil	0 – 400,000	Any type	Not required	90	90	90	Not required	Required	Not required	Not required	Required	Required	Not required	Required
F	Oil	400,001 – 1,000,000	Interrupted	Not required	30	30	2 – 4	Required	Required	Not required	Not required	Required	Required	Not required	Required
G	Oil	1,000,001 – 3,000,000	Interrupted	Not required	15	15	2 – 4	Required	Required	Not required	Not required	Required	Required	Not required	Required
H	Oil	3,000,000	Interrupted	15	15	60	2 – 4	Required	Required	Required	Required	Required	Required	Required	Required
K	Electric	All	Not required	Not required	Not required	Not required	Not required	Not required	Not required	Not required	Not required	Required	Required	Not required	Required

a. Fuel input shall be determined by one of the following:

1. The maximum burner input as shown on the burner nameplate or as otherwise identified by the manufacturer.
2. The nominal boiler rating, as determined by the Chief Mechanical Inspector, including an additional 25 percent.
3. 1 boiler horsepower = 33,475 Btu/h.

- b. Automatic boilers shall have one flame failure device on each burner, which shall prove the presence of a suitable ignition source at the point where it will reliably ignite the main burner, except that Boiler Groups A, B, E, F and G, which are equipped with direct-electric ignition, shall monitor the main burner, and all boiler groups using interrupted pilots shall monitor only the main burner after the prescribed limited trial and ignition periods. Boiler Group A, equipped with continuous pilot, shall accomplish 100 percent shutoff within 90 seconds upon pilot flame failure. The use of intermittent pilots in Boiler Group C is limited to approved burner units.
- c. In Boiler Groups B, C and D, a 90-second main burner, flame-failure limit shall apply if continuous pilots are provided on manufacturer-assembled boiler-burner units, which have been approved by an approved testing agency as complying with nationally recognized standards approved by the Chief Mechanical Inspector. Boiler Groups F and G, equipped to re-energize their ignition system within 0.8 seconds after main burner flame, will be permitted 30 seconds for Group F or 15 seconds for Group G to re-establish its main burner flame.
- d. Boiler Groups C and D shall have controls interlocked to accomplish a non-recycling fuel shut off upon high- or low-gas pressure; and Boiler Groups F, G and H, using steam or air for fuel atomization, shall have controls interlocked to accomplish a non-recycling fuel shut off upon low atomizing steam or air pressure. Boiler Groups F, G and H, equipped with a preheated oil system, shall have controls interlocked to provide fuel shut off upon low oil temperature.
- e. Automatic boilers shall have controls interlocked to shut off the fuel supply in the event of draft failure if forced or induced draft fans are used, or in the event of low combustion airflow if a gas-powered burner is used. Where a single motor directly driving both the fan and the oil pump is used, a separate control is not required.
- f. Boiler Groups C, D and H, when firing in excess of 400,000 Btu per combustion chamber, shall be provided with low fire start of its main burner system to permit smooth light off. This will normally be at a rate of approximately one-third of its maximum firing rate.
- g. Boiler Groups C, D and H shall not permit pilot or main burner trial for ignition operation before a purging operation of sufficient duration to permit a minimum of four complete air changes through the furnace, including the combustion chamber and boiler passes. Where this is not readily determinable, five complete air changes of the furnace, including the combustion chamber up to the first pass, will be considered equivalent. An atmospheric gas burner with no mechanical means of creating air movement or an oil burner which obtains two-thirds or more of the air required for combustion without mechanical means of creating air movement shall not require a purge by means of four air changes so long as its secondary air openings are not provided with a means of closing. If such burners have means of closing secondary air openings, a time delay must be provided that puts these closures in a normally open position for 4 minutes before an attempt for ignition. An installation with a trapped combustion chamber shall, in every case, be provided with a mechanical means of creating air movement for purging.
- h. Every automatic hot water boiler, low-pressure hot water-heating boiler, and power hot water boiler shall be equipped with two, high-temperature limit controls and a low-water limit control interlocked to shut off the fuel supply to the main burner, with a manual reset on the high limit control with the higher setting. Manual reset on the high-temperature limit control shall not be required on any automatic package boiler not exceeding 400,000 Btu/h input and that has been approved by a nationally recognized testing agency. The high-temperature limit and low-water limit control shall be installed in a way to permit testing, servicing and replacing of the control without draining the hydronic system, except on boilers used in a residential occupancy of less than six units. A low-water limit control installed in the circulating waterline may be used instead of the low-water level limit control installed on water-coil-type boilers.

(continued)

TABLE 1002—continued
CONTROLS AND LIMIT DEVICES FOR AUTOMATIC BOILERS

- i. Every automatic low-pressure, steam-heating boiler, small power boiler and power steam boiler shall be equipped with two, high-steam pressure limit controls interlocked to shut off the fuel supply to the main burner with manual reset on the control with the higher setting, and two, low-water level limit controls one of which shall be provided with a manual reset device and independent of the feed water controller. Coil-type flash steam boilers shall use two, high-temperature limit controls, one of which shall be manually reset in the hot water-coil section of the boiler instead of the low-water level limit control.
- j. Boiler Groups C, D and H shall use an approved automatic reset safety shutoff valve for the main burner fuel shutoff, which shall be interlocked to the programming control devices required. On oil burners, where the safety shutoff valve will be subjected to pressures in excess of 10 pounds per square inch (psi) when the burner is not operating, a second safety shutoff valve shall be provided in series with the first. Boiler Groups C and D, using gas in excess of 1 psi of pressure, or having a trapped combustion chamber or employing horizontal fire tubes, shall be equipped with two approved safety shutoff valves, one of which shall be an automatic-reset type, one of which may be used as an operating control, and both of which shall be interlocked to the limit-control devices required. Boiler Groups C and D, using gas in excess of 1 psi of pressure, shall be provided with a permanent and ready means for making periodic tightness checks of the main fuel safety shutoff valve.
- k. Control and limit device systems shall be grounded with operating voltage not to exceed 150 volts, except that, upon approval by the Chief Mechanical Inspector, existing control equipment to be reused in an altered boiler control system shall use 220-volt single-phase with one side grounded, provided such voltage is used for controls. Control and limit devices shall interrupt the ungrounded side of the circuit. A readily accessible means of manually disconnecting the control circuit shall be provided with controls so arranged that when they are de-energized the burner shall be inoperative.

SECTION 1005 **INSTALLATION**

1005.1 Installation. The installation of boilers shall conform to the manufacturer's installation instructions in addition to the requirements of this Code, and operating instructions of a permanent type shall be attached to the boiler. All boiler installations, upon completion, shall have all controls set, adjusted and tested by the installer, and a complete control diagram of a permanent legible type, together with complete boiler operating instructions, shall be furnished by the installer for each installation. The manufacturer's rating data and the nameplate shall be attached to the boiler.

SECTION 1006 **BOILER AND MACHINERY ROOMS**

1006.1 Boiler rooms. All boiler rooms shall comply with Chapters 5 and 8 of the *EPCOT Building Code*.

1006.2 Machinery rooms. Machinery rooms, which house boilers and refrigerant containing equipment, shall satisfy the requirements of Chapter 11.

CHAPTER 11

REFRIGERATION

SECTION 1101 GENERAL

1101.1 Scope. In addition to the other provisions to this Code, this Chapter is intended to ensure the safe design, construction, installation and repair of equipment used in systems pertaining to heating, air conditioning and refrigeration, which use the refrigerating cycle that vaporizes and liquifies a fluid.

1101.2 Requirements. Refrigerant piping design and installation (including pressure vessels and relief devices for use in refrigerant systems) shall conform to this Code. Permanently installed refrigerant storage systems and other components shall be considered as part of the refrigeration system to which they are attached. Other requirements not covered herein shall conform to ANSI/ASHRAE 15.

1101.3 System requirements. To determine the system classification, allowable refrigerants, the maximum quantity, enclosure requirements, location limitations and field-pressure test requirements, proceed as follows:

- (a) Determine the refrigerant system's classification, either high or low probability, according to Section 1102.
- (b) Determine the refrigerant classification from Table 1102.
- (c) Determine the maximum quantity of refrigerant in accordance with Table 1103A, based on the type of refrigerant, system classification and occupancy.
- (d) Determine the system enclosure requirements in accordance with Table 1103A.
- (e) Refrigerant equipment location and installation is subject to the limitations of Chapter 3.
- (f) Nonfactory-tested, field-erected equipment shall be pressure tested in accordance with Section 1107.

1101.4 Protection. Reasonable protection, as approved by the Chief Mechanical Inspector, shall be afforded for any portion of any refrigeration system that may be subject to damage.

1101.5 Water connection. Water supply and discharge connections shall be made in accordance with this Code and the *EPCOT Plumbing Code*.

1101.6 Gas connection. Gas-fuel devices and equipment used with refrigerating systems shall be installed in accordance with this Code and the *EPCOT Fuel Gas Code*.

1101.7 Changing refrigerant. A change in the type of refrigerant, to one with a different designation in ASHRAE 34, in a system, shall not be made without notification of the approving authority and user, evaluation for suitability, and due observance of safety requirements.

SECTION 1102 CLASSIFICATIONS

1102.1 Refrigerant classification. Refrigerants shall be classified in accordance with ASHRAE 34, and as listed in Table 1102.

1102.2 Occupancy classifications. Determine the occupancy in accordance with the *EPCOT Building Code*.

1102.3 Refrigeration system classification. Refrigeration systems shall be classified according to the degree of probability, low or high, that refrigerant leaked from a failed connection, seal or component will enter an occupied area other than a machinery room conforming to Section 1104 or 1105. The distinction is based on the basic design and location of the components.

1102.3.1 Low-probability systems. Indirect closed systems; indirect, vented closed systems; and double-indirect, open-spray systems shall be classified as low-probability systems, provided all refrigerant containing piping and fittings are isolated when the quantities in Table 1102 are exceeded.

1102.3.2 High-probability systems. Direct systems and indirect open-spray systems shall be classified as high-probability systems.

Exception: An indirect open-spray system shall be classified as a low-probability system when the pressure of the secondary coolant is at all times (operating and standby) greater than the pressure of the refrigerant.

SECTION 1103 REFRIGERANT CLASSIFICATION AND SYSTEM REQUIREMENTS

1103.1 Refrigerant classification. Refrigerants are classified as shown in Table 1102.

Exception: The quantity of water used as a refrigerant is not limited.

1103.2 System requirements. The maximum allowable refrigerant quantities are determined by the application of Table 1103A. To use Table 1103A, determine the occupancy class in accordance with the *EPCOT Building Code*, the refrigerant group in accordance with Table 1102 and the type of system in accordance with Table 1102, then locate the notes that apply.

REFRIGERATION

TABLE 1102
REFRIGERANT^a CLASSIFICATION, AMOUNT^{b, c, e} AND TLV-TWA^f

REFRIGERANT CLASSIFICATION	REFRIGERANT DESCRIPTION		AMOUNT OF REFRIGERANT PER OCCUPIED SPACE			TLV TWA ^f
	Name or blend	Chemical formula	Pound per 1,000 cubic feet ^a	Volume (percent)	Grams per cubic meter ^c	Parts per million
Group A/1						
R-11	Trichlorofluoromethane	CCl ₃ F	1.6	0.4	250	C1,000
R-12	Dichlorodifluoromethane	CCl ₂ F ₂	12	4.0	200	1,000
R-13	Chlorotrifluoromethane	CClF ₃	18	6.7	290	1,000 ^h
R-13B1	Bromotrifluoromethane	CBrF ₃	22	5.7	350	1,000
R-14	Tetrafluoromethane					
	(carbon tetrafluoride)	CF ₄	15	6.7	240	1,000 ^h
R-22	Chlorodifluoromethane	CHClF ₂	9.4	4.2	150	1,000
R-113	1, 1, 2-Trichlorotrifluoroethane	CCl ₂ FCClF ₂	1.9	0.4	300	1,000
R-114	1, 2-Dichlorotetrafluoroethane	CClF ₂ CClF ₂	9.4	2.1	150	1,000
R-115	Chloropentafluoroethane	CClF ₂ CF ₃	27	6.7	430	1,000
R-134a	1, 1, 1, 2-Tetrafluoroethane	CH ₂ FCF ₃	16	6.0	250	1,000
R-C318	Octafluorocyclobutane	-(CF ₂) ₄ -	35	6.7	550	1,000 ^h
R-400	R-12 and R-114	CCl ₂ F ₂ and C ₂ Cl ₂ F ₄	Note d	Note d	Note d	1,000
R-500	R-12 and R-152a (73.8 and 26.2)	CCl ₂ F ₂ and CH ₃ CHF ₂	12	4.7	200	1,000
R-502	R-22 and R-115 (48.8 and 51.2)	CHClF ₂ and CClF ₂ CF ₃	19	6.5	300	1,000
R-503	R-23 and R-13 (40.1 and 59.9)	CHF ₃ and CClF ₃	15	6.7	240	1,000 ^h
R-744	Carbon dioxide	CO ₂	5.7	5.0	91	5,000
Group A/2						
R-142b	1-Chloro-1, 1-Difluoroethane	CH ₃ CClF ₂	3.7	1.4	60	1,000
R-152a	1, 1-Difluoroethane	CH ₃ CHF ₂	1.2	0.7	20	1,000
Group A/3ⁱ						
R-170	Ethane	CH ₃ CH ₃	0.5	0.64	8.0	1,000 ^g
R-290	Propane	CH ₃ CH ₂ CH ₃	0.5	0.44	8.0	1,000
R-600	Butane	CH ₃ CH ₂ CH ₂ CH ₃	0.5	0.34	8.0	800
R-600a	Isobutane	CH(CH ₃) ₂ CH ₃	0.5	0.34	8.0	800 ^g
R-1150	Ethene (ethylene)	CH ₂ =CH ₂	0.4	0.52	6.0	1,000 ^g
R-1270	Propene (propylene)	CH ₃ CH=CH ₂	0.4	0.34	5.9	1,000 ^g
Group B/1						
R-123	2, 2-Dichloro-1, 1, 1-Trifluoroethane	CHCl ₂ CF ₃	0.4	0.1	6.3	30
R-764	Sulfur dioxide	SO ₂	0.016	0.01	0.26	2
Group B/2						
R-40	Chloromethane (methyl chloride)	CH ₃ Cl	1.3	1.0	21.0	50, C200
R-611	Methyl formate	HCOOCH ₃	0.78	0.5	12.0	100
R-717	Ammonia	NH ₃	0.022	0.05	0.35	25
Group B/3ⁱ						

a. Other refrigerants shall be classified in accordance with Section 1102 and ASHRAE 34.

b. To be used only in conjunction with notes from Table 1103A.

c. To correct for height, *H* (feet), above sea level, multiply these values by $(1 - 2.42 \times 10^{-6}H)$.

d. The quantity of each component shall comply with the limits set in this Table for the pure compound, and the total volume (percent) of all components shall not exceed 6.7 volume percent.

e. The basis of the table amounts is given as follows:

Group A/1—80 percent of the cardiac sensitization level for R-11, R-12, R-13B1, R-22, R-113, R-114, R-134a, R-500 and R-502; 100 percent of the IDLH for R-744. Others are limited by levels where oxygen deprivation begins to occur.

Groups A/2 and A/3—Approximately 20 percent of LFL.

Group B/1—100 percent of IDLH for R-764, and 100 percent of the measure consistent with the IDLH for R-123.

Groups B/2 and B/3—100 percent of IDLH or 20 percent of LFL, whichever is lower.

f. TLV-TWA or measure consistent therewith to be used with Section 1103.

g. Simple asphyxiants, limit set at approximately 20 percent of LFL.

h. No listed TLV-TWA, or equivalent, uses practical alarm level.

i. Group A/3 and B/3 refrigerants, as listed in this Table, shall not be used in a refrigeration system in excess of 1,000 pounds, unless approved by the Chief Mechanical Inspector.

TABLE 1103A
SYSTEM APPLICATION REQUIREMENTS
(For system classification, see Table 1102.)

REFRIGERANT GROUP	SYSTEMS CLASSIFICATION	OCCUPANCY		
		Institutional	Other occupancies	Storage/factory-industrial
A/1	High Low	Note a Note d	Note b Note d	Note c Note d
A/2	High Low	Note e Note g	Note e Note g	Note c Note g
A/3	High Low	Note i Note i	Note i Note i	Note c Note g
B/1	High Low	Notes a and f Note d	Notes b and f Note d	Note c Note d
B/2	High Low	Notes e and f Note g	Notes e and f Note g	Note c Note g
B/3	High Low	Note i Note i	Note i Note i	Note c Note g

- a. The refrigerant amount is limited to 50 percent of those listed in Table 1102, except Note b applies in kitchens, laboratories and mortuaries. If any portion of a refrigerant system containing greater than 1 pound of refrigerant (except R-744) is in a room with a flame-sustaining device, this device shall be provided with a hood to exhaust combustion products to the outside air. Otherwise, Notes e and f shall be followed.
- b. The refrigerant amount is limited as listed in Table 1102.
- c. For refrigerating systems of 100 horsepower (hp) or less, when the quantity of refrigerant in each system exceeds Table 1102 quantities, the rules for other occupancies shall apply, unless the following occurs:
- Occupancies containing machinery are separated from other occupancies by tight construction and with tight-fitting doors.
 - Access by authorized personnel is controlled.
 - Personal density and means of egress are in compliance with the *EPCOT Building Code*.
 - Detectors (refrigerant) are located in areas where refrigerant vapor from a leak will be concentrated so as to provide a warning at a concentration not exceeding the refrigerant(s) TLV-TWA (detectors are not required for ammonia due to its self-alarmer character).
 - When the quantity of refrigerant, except refrigerants in Groups A/1 and B/1, exceeds Table 1102 quantities, no flame-producing device or hot surface greater than 800°F shall be permitted.
 - When the quantity of refrigerant, except Groups A/1 and B/1, and ammonia, exceeds Table 1102 quantities, the area shall be classified as a hazardous location and all electrical equipment shall conform to the requirements of Class 1, Division 2, of NFPA 70.
For refrigerating systems of greater than 100 hp, the refrigerated work area shall comply with Items (1) through (6), and the separate room housing compressors and related equipment shall comply with Note h.
- d. When the quantity of refrigerant in the largest system exceeds Table 1102 amounts, all refrigerant-containing parts, except piping and those parts outside the building, shall be installed in a machinery room that satisfies the Level 1 requirements of Section 1104.
- e. Refrigerant amounts and types of systems are limited as shown in Table 1103B.
- f. Applications involving air conditioning for human comfort are not allowed.
- g. When the quantity of refrigerant in the largest system exceeds Table 1102 amounts, all refrigerant-containing parts, except piping and those parts outside the building, shall be installed in a Level 2 machinery room in accordance with Section 1105, with limitations on refrigerant quantities as follows:
- 550 pounds—Institutional.
 - No limit, except Note h—Public assembly.
 - No limit, except Note h—Residential.
 - No limit, except Note h—All other occupancies.

(continued)

TABLE 1103A—continued
SYSTEM APPLICATION REQUIREMENTS
(For system classification, see Table 1102.)

- No limit, except Note h—Industrial.
Otherwise, Note e applies to the amount of Group A/2, A/3, B/2 or B/3 refrigerant in the system.
- When the quantity of refrigerant exceeds Table 1102 amounts, all refrigerant-containing parts, except piping, low-side components, condensers and parts outside the building, shall be installed in a Level 1 machinery room in accordance with Section 1104.
In addition, refrigerants of Groups A/2, A/3, B/2 and B/3 shall meet the following requirements:
 - The Level 2 machinery room requirements of Section 1105.
 - Except for ammonia, amounts in excess of 1,100 pounds shall be approved by the authority having jurisdiction.
- Use of these refrigerants is prohibited, except in laboratories in commercial occupancies. Only unit systems containing not greater than 6.6 pounds of Group A/3 or B/3 refrigerant shall be used, unless the laboratory is occupied by less than one person per 100 square feet of floor area, in which case the requirements of industrial occupancies shall apply.

TABLE 1103B
MAXIMUM PERMISSIBLE QUANTITIES OF REFRIGERANTS
(For use with Note e of Table 1103A)

TYPE OF REFRIGERATION SYSTEM	MAXIMUM POUNDS FOR VARIOUS OCCUPANCIES			
	Institutional	Assembly	Residential	All other occupancies
Sealed absorption system				
In exit access	0	0	3.3	3.3
In adjacent outdoor locations	0	0	22	22
In other than exit access	0	6.6	6.6	22
Unit systems				
In other than exit access	0	0	6.6	22

1103.3 Volume calculation.

1103.3.1 Unventilated spaces. When the refrigerant containing parts of a system are located in one or more unventilated spaces, the volume of the smallest, enclosed occupied space, other than a machinery room, shall be used to determine the permissible quantity of refrigerant in the system. Where a building consists of several stories of unpartitioned space, such as a mezzanine or an atrium, the story having the smallest occupied space will be deemed to be the enclosed space.

1103.3.2 Ventilated spaces. When an evaporator or condenser is located in an air duct system, the volume of the smallest occupied space, or unpartitioned building story, served by the duct will determine the permissible quantity of refrigerant in the system.

Exception: If airflow to any enclosed space cannot be reduced to less than one-quarter of its maximum, the entire space served by the air duct system shall be used to determine the permissible quantity of refrigerant in the system.

1103.3.3 Plenums. When the space above a suspended ceiling is continuous and part of the supply or return air plenum system, this space shall be included in calculating the volume of the enclosed space.

SECTION 1104 LEVEL 1 MACHINERY ROOM

1104.1 General.

1104.1.1 Machinery room. When required by Table 1103A, a machinery room shall be provided to enclose refrigeration systems located indoors. Other mechanical equipment shall be permitted in the machinery room.

1104.1.2 Working clearances. A machinery room shall be so dimensioned to provide clearance in accordance with Chapter 3. There shall be clear headroom of not less than 7¹/₄ feet below equipment situated over passageways.

1104.2 Opening protectives.

1104.2.1 Doors. Each refrigerating machinery room shall have self-closing, weatherstripped doors opening outward, and satisfying the egress criteria of the *EPCOT Building Code*.

Exception: Self-closing devices are not required for doors opening directly to the exterior.

1104.2.2 Openings. Openings that could permit the passage of escaping refrigerant to other parts of the building are prohibited.

Exception: Doors, ducts and air-handling equipment that have gasketed and tight-fitting access doors and panels.

1104.3 Refrigerant detector. Machinery rooms shall contain a refrigerant detector with an audible and visual alarm. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak is likely to concentrate. The alarm shall be actuated at a value not greater than the corresponding TLV-TWA values shown in Table 1102. Location of detectors and alarms are subject to the approval of the Chief Mechanical Inspector.

Exception: Detectors are not required for ammonia systems complying with Subsection 1105.6.

1104.4 Tests. Periodic tests of the detector, alarm and mechanical ventilating system shall be performed in accordance with manufacturer's recommendations and/or the local authority having jurisdiction.

1104.5 Fuel-burning equipment. No open flames that use combustion air from the machinery room shall be installed.

Exceptions:

1. Matches, lighters, halide leak detectors and similar devices.
2. Where the refrigerant is carbon dioxide or water.
3. Fuel-burning equipment is permitted in the same machinery room with refrigerant-containing equipment when combustion air is ducted from outside the machinery room and sealed in such a manner as to prevent any refrigerant leakage from entering the combustion chamber, or a refrigerant vapor detector is employed to automatically shut off the combustion process in the event of refrigerant leakage.

1104.6 Sign. A sign shall be posted on the machinery room door prohibiting the access of unauthorized personnel.

1104.7 Ventilation—general.

1104.7.1 General. Machinery rooms shall be mechanically ventilated to the outdoors. Mechanical ventilation shall be capable of exhausting the minimum quantity of air both at the normal operating and emergency conditions. Multiple fans or multiple-speed fans shall be permitted in order to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.

Exception: When a refrigerating system is located outdoors greater than 20 feet from any building opening, and is enclosed by a penthouse, lean-to or other open structure, natural ventilation shall be permitted. Location of the openings shall be with due regard for the relative density of the refrigerant to air. The free-aperture cross section for the ventilation of the machinery room shall amount to a minimum of:

$$F = G^{0.5}$$

or

$$(F = 0.138G^{0.5})$$

where:

F = The free opening area, in square feet.

G = The mass of refrigerant, in pounds, in the largest system, any part of which is located in the machinery room.

1104.7.2 Discharge location. The discharge of the air shall be to the outdoors in accordance with Section 505.

1104.7.3 Supply air. Provisions shall be made for supply air to replace that being exhausted. Openings for supply air shall be positioned to avoid the intake of exhaust air. Air supply and exhaust ducts to the machinery room shall serve no other area, be of materials allowed in Subsection 501.5, and covered with a corrosion-resistant screen of not less than 1/4-inch mesh.

1104.7.4 Quantity—normal ventilation. During occupied conditions, the mechanical ventilation system shall exhaust the greater of the following:

- (a) A minimum of 1/2 cubic foot per minute (cfm) per square foot of machinery room area or 20 cfm per person; and
- (b) A volume required to maintain a maximum temperature rise of 18°F based on all of the heat-producing machinery in the room.

1104.7.5 Quantity—emergency conditions. Upon actuation of the refrigerant detector required in Subsection 1104.3, the mechanical ventilation system shall exhaust air from the machinery room in the following quantity:

$$Q = 100 \times G^{0.5}$$

or

$$(Q = 70 \times G^{0.5})$$

where:

Q = The airflow, in cfm.

G = The design mass of refrigerant, in pounds, in the largest system, any part of which is located in the machinery room.

1104.8 Breathing apparatus. A minimum of one approved, self-contained breathing apparatus, suitable for the refrigerant used, shall be available to authorized personnel at a location convenient to the machinery room.

1104.9 Termination of relief devices. In the equipment room, pressure relief devices, fusible plugs and purge systems shall terminate outside of the structure at a location not less than 15 feet above the adjoining ground level and not less than 20 feet from any window, ventilation opening or exit to any building.

SECTION 1105 LEVEL 2 MACHINERY ROOM

1105.1 General. Where required by Table 1103A, the machinery room shall meet the requirements of this Section in addition to the requirements of Section 1104.

1105.2 Elevated temperature. There shall be no flame-producing device or continuously operating hot surface greater than 800°F permanently installed in the room.

1105.3 Construction requirements. The machinery room shall be separated from other occupied spaces with noncombustible, smoke-tight, 1-hour fire-resistant construction.

1105.4 Opening protectives.

1105.4.1 Doors. Opening protection between the machinery room and other occupied spaces shall be approved, self-closing, tight-fitting, minimum $\frac{3}{4}$ -hour Type C fire doors.

1105.4.2 Penetrations. All pipes piercing the interior walls, ceiling or floor of such rooms shall be sealed in accordance with Chapter 7 of the *EPCOT Building Code*.

1105.4.3 Exterior openings. Exterior openings shall not be under any exit, stairway or exit discharge.

1105.4.4 Access panels. Access doors and panels in ducts and air-handling equipment shall be gasketed and tight fitting.

1105.5 Egress. Each machinery room shall be provided with a minimum of one exit door that opens directly to the outside.

Exception: Self-closing, tight-fitting doors opening into a vestibule leading directly outside.

1105.6 Ammonia room ventilation. Ventilation equipment in ammonia machinery rooms shall be operated continuously.

Exceptions:

1. Machinery rooms equipped with a vapor detector that will automatically start the ventilation system and actuate an alarm when the refrigerant level is not greater than 4 percent by volume; or
2. Machinery rooms conforming to Class 1, Division 2, of NFPA 70.

1105.7 Group 2 and 3 refrigerants. Where refrigerants of Groups A/2, A/3, B/2 and B/3 are used, the machinery room shall conform to Class 1, Division 2, of NFPA 70.

Exception: Ammonia machinery rooms.

1105.8 Remote controls.

1105.8.1 Control location. Remote control of the mechanical equipment located in the machinery room shall be provided immediately outside the machinery room.

1105.8.2 Access. Access to remote controls shall be limited to authorized personnel.

1105.8.3 Ventilation control. Ventilation fans shall be on a separate circuit and shall have a control switch located immediately outside the machinery room.

1105.8.4 Approval. Location and access to these controls shall be subject to the approval of the Chief Mechanical Inspector.

SECTION 1106 REFRIGERANT PIPING

1106.1 General. All refrigerant piping shall be sized, installed, tested and placed in operation in accordance with this Chapter and the *ASHRAE Handbook of Fundamentals*.

1106.2 Pipe enclosures. Rigid or flexible metal enclosures or pipe ducts shall be provided for soft, annealed copper tubing and used for refrigerant piping erected on the premises, and containing other than Group 1 refrigerants. No enclosures shall be required for connections between a condensing unit and the nearest riser box, provided such connections do not exceed 6 feet in length.

1106.3 Condensation. All refrigerating piping and fittings, or brine piping and fittings, which, during normal operation, could reach a surface temperature below the dew point of the surrounding air, and are located in spaces or areas where condensation could cause a safety hazard to the building occupants, structure, electrical equipment or any other equipment, shall be protected in a manner to prevent such damage.

1106.4 Corrosion resistance. Piping systems supplying or passing through corrosive atmospheres shall be constructed of corrosion-resistant materials or otherwise suitably coated as approved by the Building Official.

1106.5 Materials for refrigerant pipe and tubing.

1106.5.1 Steel pipe. Not less than Schedule 80 wall thickness carbon steel or wrought-iron pipe shall be used for Group A/2, B/2, A/3 and B/3 refrigerant liquid lines for sizes $1\frac{1}{2}$ inches and less. Not less than Schedule 40 wall thickness carbon steel or wrought-iron pipe shall be used for Group A/1 and B/1 refrigerant liquid lines 6 inches and less; Group A/2, B/2, A/3 and B/3 refrigerant liquid lines sizes 2 inches through 6 inches; and Group A/1, B/1, A/2, B/2, A/3 and B/3 refrigerant vapor lines 6 inches and less. Butt-welded carbon steel and butt-welded wrought-iron pipe shall not be used for refrigerant liquid lines.

1106.5.2 Cast iron. Cast-iron pipe shall not be used for Group A/1, B/1, A/2, B/2, A/3 or B/3 refrigerant lines.

1106.5.3 Copper and brass. Standard iron pipe size, copper and red brass (not less than 80 percent copper) pipe shall be used, and shall conform to ASTM B42 and ASTM B43.

1106.5.4 Copper tube. Watertube size hard copper tubing used for refrigerant piping erected on the premises shall conform to ASTM B88 for dimensions and specifications, except that copper tubing with an outside diameter (OD) of $\frac{1}{4}$ inch and $\frac{3}{8}$ inch shall have a minimum nominal wall thickness of not less than 0.030 inch and 0.034 inch, respectively.

1106.5.5 Soft annealed copper tubing. Soft annealed copper tubing used for refrigerant piping erected on the premises shall not be used in sizes greater than $\frac{1}{8}$ -inch OD standard size. Mechanical joints shall not be used on soft annealed copper tubing on sizes greater than $\frac{7}{8}$ -inch OD standard size. Tubing shall conform to ASTM B280.

1106.5.6 Copper tubing joints. Copper tubing joints used in refrigeration systems containing Group A/2, B/2, A/3 or B/3 refrigerants shall be brazed. Soldered joints shall not be used in such refrigerating systems.

1106.5.7 Aluminum tube. Type 3003-0 aluminum tubing with high-pressure fittings shall be used with all refrigerants, except methyl chloride and those others known to attack aluminum.

1106.6 Joints and refrigerant-containing parts in air ducts. Joints and all refrigerant-containing parts of a refrigeration system located in an air duct of an air-conditioning system carrying conditioned air to and from humanly occupied space shall be constructed to withstand, without leakage, a temperature of 700°F.

1106.7 Exposure of refrigerant pipe joints. Refrigerant pipe joints erected on the premises shall be exposed for visual inspection prior to being covered or enclosed.

1106.8 Stop valves.

1106.8.1 Installation. All systems containing greater than 6.6 pounds of a refrigerant shall have stop valves installed as follows:

- (a) Each inlet of each compressor, compressor unit or condensing unit.
- (b) Each discharge outlet of each compressor, compressor unit or condensing unit, and of each liquid receiver.

Exception: Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge; systems equipped with the provisions for a pumpout of the refrigerant; or self-contained systems.

1106.8.2 Liquid receivers. All systems containing greater than or equal to 110 pounds of a refrigerant shall have stop valves, in addition to those in Subsection 1106.8.1, on each inlet of each liquid receiver. Stop valves shall not be required on the inlet of a receiver in a condensing unit nor on the inlet of a receiver that is an integral part of the condenser.

Exception: Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge; systems equipped with the provisions for a pumpout of the refrigerant; or self-contained systems.

1106.8.3 Copper tubing. Stop valves used with soft annealed copper tubing or hard-drawn copper tubing $\frac{7}{8}$ -inch OD standard size or less shall be securely mounted, independent of tubing fastenings or supports.

1106.8.4 Identification. Stop valves shall be suitably labeled if their purpose is not obvious. Numbers may be used to label the valves, provided a key to the numbers is located near the valves.

SECTION 1107 FIELD TEST

1107.1 General. Every refrigerant containing part of every system that is erected on the premises, except compressors, condensers, vessels, evaporators, safety devices, pressure gages and control mechanisms that are listed and factory-tested, shall be tested and proved tight after complete installation, and before operation, at not less than the minimum refrigerant leak field test pressures shown in Table 1107 and this Section.

1107.2 Testing.

1107.2.1 Gas bulk storage. Leak test pressure requirements of Table 1107 are not intended to apply to gas bulk storage tanks that are not permanently connected to a refrigeration system. (See ANSI/ASHRAE 15.)

1107.2.2 Refrigerant charged. Systems erected on the premises using Group A/1 refrigerant, with copper tubing not exceeding $\frac{5}{8}$ -inch OD, and wall thickness as required by ANSI/ASHRAE 15, shall be tested by means of refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 70°F or higher.

1107.2.3 Pressure limits. Limited charged systems equipped with a pressure relief device, erected on the premises, shall be tested at a pressure not less than $1\frac{1}{2}$ times the pressure setting of the relief device. If the equipment has been tested by the manufacturer at $1\frac{1}{2}$ times the design pressure, the test after erection on the premises shall be conducted at the design pressure.

1107.2.4 Test gases. Tests shall be performed with an inert dried gas including, but not limited to, nitrogen or carbon dioxide. Oxygen, air, toxic or combustible gases, and mixtures containing them, shall not be used.

Exception: Use of air is allowed to test R-717 (ammonia) systems, provided that they are subsequently evacuated before charging with refrigerant.

1107.2.5 Test apparatus. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device, and a gage on the outlet side.

1107.3 Declaration. A dated declaration of test shall be provided for all systems containing greater than or equal to 55 pounds of refrigerant. The declaration should give the name of the refrigerant and the field test pressure applied to the high side and the low side of the system. The declaration of test shall be signed by the installer and, if the Chief Mechanical Inspector is present during the tests, he shall make the declaration part of the public record. When requested, copies of this declaration shall be furnished to the authority having jurisdiction.

TABLE 1107
MINIMUM FIELD TEST PRESSURES
FOR REFRIGERANT LEAKS^{a, b, c}

REFRIGERANT NAME AND NUMBER	CHEMICAL FORMULA	MINIMUM TEST PRESSURE (psi)	
		High side	Low side
Ammonia (R-717), air-cooled	NH ₃	300	150
Ammonia (R-717), water-cooled	NH ₃	250	150
Bromotrifluoromethane (R-13B1)	CBrF ₃	435	245
Butane (R-600)	CH ₃ CH ₂ CH ₂ CH ₃	95	50
Carbon dioxide (R-744)	CO ₂	1,500	1,000
1-Chloro-1, 1-Difluoroethane (R-142b)	CH ₃ CClF ₂	100	60
Chloropentafluoroethane (R-115)	CClF ₂ CF ₃	250	150
Dichlorodifluoromethane (R-12)	CCl ₂ F ₂	235	140
Dichlorodifluoromethane (73.8%) and ethylidene fluoride (26.2%) (R-500)	CCl ₂ F ₂ and CH ₃ CHF ₂	285	150
1, 2-Dichlorotetrafluoroethane (R-114)	CClF ₂ CClF ₂	50	50
1, 1-Difluoroethane (R-152a)	CH ₃ CHF ₂	200	100
Ethane (R-170)	CH ₃ CH ₃	1,200	700
Ethane, 2, 2-Dichloro-1, 1, 1-Trifluoroethane (R-123)	CHCl ₂ CF ₃	20	20
1, 1, 1, 2-Tetrafluoroethane (R-134a)	CH ₂ FCF ₃	235	140
-Tetrafluoro (R-134a) and ethylene (R-1150)	CH ₂ FCF ₃ and CH ₂ =CH ₂	1,600	1,200
Methyl chloride (R-40)	CH ₃ Cl	210	120
Methyl formate (R-611)	HCOOCH ₃	50	50
2-Methyl propane (isobutane) (R-600a)	CH(CH ₃) ₂ CH ₃	100	50
Monochlorodifluoromethane (R-22)	CHClF ₂	300	150
Monochlorodifluoromethane (48.8%) and monochloropentafluoroethane (51.2%) (R-502)	CHClF ₂ and CClF ₂ CF ₃	300	170
Monochlorotrifluoromethane (R-13)	CClF ₃	685 ^d	685 ^d
Octafluorocyclobutane (R-C318)	-(CF ₂) ₄ -	130	70
Propane (R-290)	CH ₃ CH ₂ CH ₃	300	150
Propane (propylene) (R-1270)	CH ₃ CH=CH ₂	350	200
R-12 and R-114 (R-400)	CCl ₂ F ₂ and CClF ₂ CClF ₂	235	140
R-23 (40.1%) and R-13 (59.9%) (R-503)	CHF ₃ and CClF ₃	620	620
Sulphur dioxide (R-764)	SO ₂	170	85
Tetrafluoromethane (carbon tetrafluoride) (R-14)	CF ₄	530	530
Trichloromonofluoromethane (R-11)	CCl ₃ F	20	20
1, 1, 2-Trichlorotrifluoroethane (R-113)	CCl ₂ FCClF ₂	20	20

a. For refrigerants not listed in this Table, the test pressure for the high-pressure side shall be not less than the saturated vapor pressure of the refrigerant at 150°F. The test pressure for the low-pressure side shall be not less than the saturated vapor pressure of the refrigerant at 110°F. However, the test pressure for either the high or low side need not exceed 125 percent of the critical pressure of the refrigerant. In no case shall the test pressure be less than 20 pounds per square inch (psi).

(continued)

TABLE 1107—continued
MINIMUM FIELD TEST PRESSURES
FOR REFRIGERANT LEAKS^{a, b, c}

- b. When a compressor is used as a booster to obtain a low pressure and discharges into the suction side of another system, the booster compressor is considered a part of the low side, and values listed under the low-side column in this Table shall be used for both the high and low side of the booster compressor, provided that a low-pressure stage compressor of the positive-displacement type is protected by a pressure relief device.
- c. In field testing systems using nonpositive displacement compressors, the entire system shall be considered a low-side pressure for field test purposes.
- d. Critical pressure is 561 psi at critical temperature of 83.9°F. (See Note a.)

CHAPTER 12

HYDRONIC PIPING

SECTION 1201 GENERAL

1201.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of hydronic piping systems.

1201.2 Pumps and pump motors.

1201.2.1 External. Pumps external to listed equipment and used for the circulation of water or other liquid flow in heating, ventilating and air-conditioning (HVAC) systems shall comply with the requirements for design and operation of ASME B73.1.

1201.2.2 Synchronous motors. Synchronous motors that are part of an HVAC system shall comply with ANSI C50.11.

1201.2.3 Insulated pumps. Pumps that are required to be insulated for condensation control shall have the pump boxes manufactured to allow the pump impellers to be accessible without damage to the insulated pump box.

1201.3 Water-cooling towers and condensers.

1201.3.1 Construction. The construction and supports for water-cooling towers, evaporating condensers and air-cooled condensers shall comply with the requirements of the *EPCOT Building Code*.

1201.3.2 Discharge. Water from such units shall be discharged into an approved disposal system in accordance with the *EPCOT Plumbing Code*. All water supply, waste water and connections shall comply with the requirements of the *EPCOT Plumbing Code*.

1201.4 Makeup water piping.

1201.4.1 General. From an approved backflow preventer installed as required by the *EPCOT Plumbing Code*, to the inlet on a boiler, chiller or other water-using device covered by this Code, the piping shall be as hereinbefore specified for hot and chilled water piping, except on boilers operating at greater than 250°F or 100 pounds per square inch (psi), the makeup water line shall be black-iron or wrought-iron pipe conforming to Schedule 80 of ANSI B36.10M and extra-heavy malleable iron fittings. Makeup water piping to chillers or water towers shall be either galvanized steel or copper pipe.

1201.4.2 Cross connections. A direct cross connection shall not be permitted between the potable water supply and any other circulating water system, except as approved in Chapter 5 of the *EPCOT Plumbing Code*.

1201.5 Corrosive atmospheres. Piping systems exposed to or passing through corrosive atmospheres shall be constructed of corrosive-resistant materials or otherwise suitable coated as approved by the Building Official.

SECTION 1202 PANEL HEATING SYSTEMS

1202.1 Installation.

1202.1.1 Construction. The installation of panel heating systems shall be designed and installed in strict accordance with accepted engineering practices and the requirements of this Code.

1202.1.2 Piping. All other piping, in all cavities or running exposed, shall be installed as permitted by this Code.

1202.1.3 Assemblies. Where piping, ducts or electrical heating systems are used in gypsum assemblies, the operating temperatures of these heating systems shall not exceed 125°F.

1202.2 Materials. All piping shall be standard weight steel pipe, Type M copper tubing, or polybutylene (PB) plastic pipe or tubing rated at 100 psi at 180°F.

1202.3 Joints. The following joints are acceptable for piping embedded in concrete or plaster:

- (a) Steel pipe joints shall be welded.
- (b) Copper tubing shall be joined with brazing rods having a melting point of 1,000°F.
- (c) PB pipe and tubing joints shall be installed with socket-type, heat-fused PB fittings.

1202.4 Testing. All embedded piping or tubing shall be tested for leaks by the hydrostatic test method by applying a pressure of not less than 150 psi water pressure or 1½ times the operating pressure, whichever is greater. The pressure shall be maintained for a minimum period of 4 consecutive hours, during which all joints shall be visually inspected for leaks.

SECTION 1203 STEAM AND HOT WATER PIPING

1203.1 General. Steam and hot water piping shall conform to the standards listed in Table 1203. The system shall be designed to operate within the specified pipe or tubing working pressure and temperature rating.

TABLE 1203
STEAM AND HOT WATER PIPING MATERIALS

MATERIALS	STANDARDS	REMARKS
Polybutylene	ANSI/ASME B31.9; ASTM D3309	Hot water piping only
Steel	ASTM A53/A53M	Schedule 40
Copper pipe	ASTM B42	
Brass pipe	ASTM B43	
Copper tube	ASTM B88	

1203.2 Reaming. After cutting, all pipe or tubing shall be reamed to not less than full internal dimensions.

1203.3 Pipe joining. PB pipe and tubing shall be joined by fusion, insert fittings and crimp rings, or mechanical fittings. Steel piping shall be joined by welding, or by the use of screw or flanged fittings, or mechanical fittings. Copper tubing shall be joined by brazing, soldering in accordance with ASTM B813 and ASTM B828, or approved compression fittings.

Exception: For joints in embedded construction, see Section 1202.

1203.4 Pipe support.

1203.4.1 Expansion and contraction. Pipe and piping shall be properly hung and supported to permit expansion and contraction. U-bends, swing joints or expansion joints shall be installed so as to permit free expansion and contraction of the piping. Swing joints or U-bends shall be fabricated of equivalent pipe material, and shall be suitable for the pressures and temperatures at which the installation is designed to operate. Expansion joints of either the slip-sleeve or corrugated-copper type may be used where such joints meet the temperature and pressure requirements of the installation.

1203.4.2 Supports or hangers. All piping shall be securely supported on substantial noncombustible supports or hangers. Such supports or hangers shall be securely fastened to an adequate support or structural member. The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings or valves, so sagging will not occur in the pipe between points of suspension under normal operating conditions. All piping shall be supported in conformance to the manufacturer's recommendations and Subsection 301.4.2.

1203.4.3 Anchoring. The piping shall be securely fastened to proper-type anchor foundations where necessary to prevent undue stress or strain on boilers or equipment due to the weight of the pipe, or expansion and contraction.

1203.5 Piping through walls, floors, etc.

1203.5.1 Installation. Piping passing through walls, ceilings, floors, in or under concrete slabs, beams, or any portion of the building structure, shall be free to expand and contract. Such piping shall not be embedded in plaster, concrete or masonry. Such piping shall be provided with metal sleeves or thimbles when passing through concrete or masonry walls, ceilings, floors or beams, and such sleeves or thimbles shall be a minimum of $\frac{3}{8}$ inch greater than the outside diameter (OD) of the pipe or the pipe plus insulation. Openings through wooden floors, ceilings, walls and beams shall be a minimum of $\frac{3}{8}$ inch greater than the OD of the pipe or the pipe plus insulation. Piping penetrating fire-resistant assemblies shall not reduce the fire rating of the assembly. The Chief Mechanical Inspector shall approve the type of sleeve and insulation to be used on piping carrying steam, water or other fluids at temperatures in excess of 300°F.

Exception: Piping for panel heating systems shall be embedded in accordance with Section 1202.

1203.5.2 Steam piping. Steam piping serving areas other than stair heating units shall not be located in or pass through exit enclosures.

1203.6 Vertical piping secured. Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents, but in no case less than at every other story height.

1203.7 Branch main stress. Where the main steam supply, or hot water supply piping or the main return piping of a system, is divided into two or more branch mains or returns, such branches from the main piping shall be taken off with tees and elbows, or "Y" branch fittings, so installed and connected that undue stresses or strains from pipe expansion or other causes shall not be placed on the pipe fittings or threads at the point or points of junction of the piping.

1203.8 Bull-heading tees. The use of bull-heading tee connections is prohibited where the side opening of a tee is connected to the main piping and where the two branch connections are taken off the run of the tee thereby forming a rigid connection.

1203.9 Welding. Where welding is used as a means of connection or joining branch mains to the main steam piping, provisions shall be made for the expansion of the pipe at this point so that undue stresses or strains shall not be placed on the welds or piping. The bull-heading or rigid tee is prohibited on this type of connection.

1203.10 Connection from mains, branch mains or return piping. All connections from the mains, branch mains or return piping of a steam system to radiators, or to supply risers running to upper floors of a building, shall be taken off at the top of the supply or return piping by use of a 45-degree or 90-degree elbow where fittings are used, or welded into the top of the piping where the welded method of connection is used.

1203.11 Cold water supply to hot water tank. The cold water supply to a hot water tank shall be discharged within 3 inches of the bottom of the tank either by a direct connection at this point, or by means of a pipe or tube inside the tank. There shall be installed on the cold water line close to the tank a hand shutoff valve and a vacuum relief valve. The vacuum relief valve shall be installed so that hot water cannot flow back from the tank through the cold water supply piping. (See the *EPCOT Plumbing Code*.)

1203.12 Materials.

1203.12.1 Threaded joints. All threads on pipe, fittings, valves, flanges and similar appurtenances shall conform to ANSI B2.1.

1203.12.2 Gaskets. Required gaskets shall be made of material approved for the pressure and temperature to which they are to be subjected. Rubber shall not be used where pressures exceed 15 psi steam and 45 psi water, or on temperatures greater than 250°F.

1203.12.3 Joint compound. Threaded joints shall be made up with an approved thread compound or lubricant.

1203.12.4 Flanged joints. Flanges, screw-type, cast-iron or steel, or of the forged-integral type, shall be used up to

their working pressure and temperature ratings. All companion flanges shall have matching facing and drilling.

1203.12.5 High pressure. All pipe fittings and valves used on high-pressure installations shall be of the type designed for the pressures and temperatures of the installation.

1203.12.6 Stress relief. All pipe and piping used on high-pressure, high-temperature installations shall be of the required weight and strength suitable for the type of service and pressures intended. Stress relieving shall be required by the Chief Mechanical Inspector for high-pressure, high-temperature welded installations.

1203.12.7 Dissimilar metals. Approved dielectric fittings and nipples shall be used to join dissimilar metals.

SECTION 1204 CHILLED WATER PIPING

1204.1 General. All chilled water piping and fittings shall be of steel, copper, brass, PB or polyvinyl chloride (PVC) plas-

tic, Schedule 40, Types I and II, high and normal impact; PVC Schedule 80, Types I and II, high and normal impact. The aforementioned materials shall be installed in compliance with Table 1204.

1204.2 Buried installations. Type K, L or M copper shall be used on all underground or underslab copper lines, and joined by a brazing filler metal.

1204.3 Type 3003-0 aluminum tubing. Type 3003-0 aluminum tubing shall be used for chilled water piping only.

1204.4 Marking. All piping and fittings shall be marked to indicate type, weight or pressure, as applicable.

1204.5 Plastic pipe installation. All plastic pipe shall be installed and supported in accordance with the manufacturer's recommendations and in such a manner as to give protection from physical damage to the piping, and shall not be used as a connection material to heating devices, nor other equipment where temperature and/or vibration could affect the piping.

**TABLE 1204
CHILLED WATER PIPE SPECIFICATIONS**

MATERIALS	STANDARDS	TYPE	MAXIMUM PRESSURE (psi)	MAXIMUM TEMPERATURE (°F)	MAXIMUM SIZE (inches)	JOINT TYPE
PE Sch. 40	ASTM D2104 ASTM D2239	II	75	73.4	—	Mechanical
PE (SDR-PR)	ASTM D2239	II	75	73.4	—	Mechanical
PVC Sch. 40		I, normal impact	50	100	6	Solvent
PVC Sch. 40	ASTM D1785	II, high impact	50	100	3	Solvent
PVC Sch. 80		I, normal impact	50	100	12	Solvent
PVC Sch. 80	ASTM D2241	II, high impact	50	100	6	Solvent
PVC Sch. 80		I, normal impact	50	100	6	Threaded
PVC Sch. 80		II, high impact	50	100	1 ¹ / ₄	Threaded
Steel	ASTM A53	Schedule 40	125	—	—	Threaded, welded or mechanical grooved couplings/ fittings
Copper	ASTM B88	K, L and M	200 Nonshock	310	—	Joined by brazing filler metal
PB (SDR 11)	ASTM D3309, including Appendix	II	100	180	2	Insert, mechanical or fusion
PB (SDR 15)	ASTM D2662, including Appendix	II	125	73	6	Insert or mechanical
(SDR 11.5)			160	73		
(SDR 9)			200	73		
(SDR 7)			250	73		
PB (SDR 13.5)	ASTM D2666, including Appendix	II	160	73	2	Mechanical or fusion
(SDR 9)			250	73		
PB (SDR 17)	ASTM D3000, including Appendix	II	125	73	6	Mechanical fusion or flange
(SDR 13.5)			160	73		
(SDR 11)			200	73		
(SDR 9)			250	73		

SECTION 1205 CONDENSER WATER PIPING

1205.1 General. Condenser water piping shall be of the same quality and installed in the same manner as required in Section 1204.

1205.2 Bleed-off. All cooling tower bleed-off lines shall be extended to a sanitary sewer drain or storm sewer drain. Such drain shall not in any case be allowed to drain into yards, street or alleys, or on the roof of a building that drains into such an area.

1205.3 Installation. Cooling towers shall be provided with a direct connection to a water supply through an individual float control valve. The control valve shall terminate not less than 3 inches above the highest possible water level in the cooling tower pan. A convenient means shall be provided, either a gate valve or a capped nipple, for draining or flushing the tower.

SECTION 1206 WATER-SOURCE, HEAT-PUMP PIPING

1206.1 General. Water-source, heat-pump systems are classified by their application and corresponding operating temperature ranges. In commercial buildings, the temperatures typically range from 60°F to 95°F. In ground-coupled systems, the temperatures may range from 25°F to 105°F.

1206.2 Piping installation.

1206.2.1 Construction. Water-source, heat-pump systems that have boiler and cooling tower components included in their application to maintain design operating temperature ranges, shall have piping of the same quality and installed in the same manner as required in Sections 1203 and 1204.

1206.2.2 Heat-pump piping. Ground-coupled heat-pump system piping and fittings shall be either polyethylene (PE) or PB materials complying with Table 1206.2A, and shall be installed in compliance with Table 1206.2B and the requirements of Subsection 1204.5. PVC pipe shall not be used for the buried portion of the ground heat exchanger.

**TABLE 1206.2B
WATER-SOURCE, HEAT-PUMP PIPE-FUSION
JOINING SPECIFICATIONS**

MATERIALS	STANDARDS	RESIN	JOINT TYPE
PE 3408; SCH 40; SDR 11	ASTM D2683; ASTM D3261	Low and medium density High density	Butt fusion Socket fusion Butt fusion
PB 2110; SDR 13.5; SDR 17	ASTM D2683	All	Socket fusion

**TABLE 1206.2A
WATER-SOURCE, HEAT-PUMP PIPE SPECIFICATIONS**

MATERIALS	STANDARDS	TYPE	CLASS	GRADE	MAXIMUM SIZE (inches)	JOINT TYPE
PE 3408; SCH 40; SDR 11	ASTM D1693; ASTM D2513; ASTM D3350; ASTM F714	II, III	B, C	P34	2	Fusion
PB 2110; SDR 13; SDR 13.5	ASTM D2581	II, III	B, C	P34	2	Fusion

CHAPTER 13

FUEL GAS PIPING

SECTION 1301 GENERAL

1301.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of fuel gas piping.

SECTION 1302 NATURAL GAS PIPING

1302.1. Installation. All natural gas fuel piping shall be sized, installed, tested and placed in operation in accordance with the requirements of the *EPCOT Fuel Gas Code*.

SECTION 1303 LIQUEFIED PETROLEUM GAS (LP-GAS) PIPING

1303.1 Installation. All LP-gas fuel piping shall be sized, installed, tested and placed in operation in accordance with the requirements of the *EPCOT Fuel Gas Code*.

CHAPTER 14

SPECIAL PIPING AND STORAGE SYSTEMS

SECTION 1401 GENERAL

1401.1 Scope. This Chapter is intended to ensure the safe design, construction, installation and repair of special piping and storage systems.

1401.2 Fuel piping and connections.

1401.2.1 Fuel type. Each appliance shall be designed for use with the type of fuel to which it will be connected. Such appliance shall not be converted from the fuel specified on the rating plate for use with a different fuel without securing reapproval from the Chief Mechanical Inspector.

1401.2.2 Fuel tanks, piping and valves. The tank, piping and valves for appliances burning oil shall be installed in accordance with the requirements of this Chapter. When an oil burner is served by a tank, any part of which is above the level of the burner inlet connection, and where the fuel supply line is taken from the top of the tank, an approved anti-siphon valve or other siphon-breaking device shall be installed in lieu of the shutoff valve.

1401.2.3 Gas supply connection. All appliances designed to burn gas shall be connected to the gas supply outlet in accordance with the *EPCOT Fuel Gas Code*.

SECTION 1402 LIQUID FUEL PIPING

1402.1 Piping materials and design.

1402.1.1 Materials. All piping shall be wrought-iron, steel or brass pipe, or brass or copper tubing. Piping may be of materials other than these if used underground. Such piping shall be designed to specifications embodying principles recognized as good engineering design for the material used and shall be approved by the authority having jurisdiction.

1402.1.2 Wall thickness. Wall thicknesses of wrought-iron and steel pipe shall be in accordance with the design methods outlined in ANSI B36.10. Listed flexible metal hose may be used to reduce the effect of jarring and vibration, or where rigid connections are impracticable and shall be installed in full compliance with its listing.

1402.1.3 Piping size. Piping used in the installation of oil burners and appliances, other than conversion range oil burners, shall be not less than $\frac{3}{8}$ -inch iron pipe size or $\frac{3}{8}$ -inch outside diameter (OD) tubing, except that $\frac{1}{4}$ -inch pipe or $\frac{5}{16}$ -inch OD tubing may be used in the suction line of systems where the top of the tank is below the level of the oil pump. Copper tubing shall have 0.035-inch-nominal and 0.032-inch-minimum wall thickness.

1402.1.4 Connections. Pipe shall be connected with standard fittings and tubing with fittings of a listed type. Pipe connectors made of combustible materials, depending

upon the frictional characteristics of combustible materials, shall not be used inside of buildings or above ground outside of buildings. If used below ground outside of buildings, connectors shall be of a listed type and installed in accordance with their listing. All threaded joints and connections shall be made tight with suitable lubricant or pipe compound. Unions requiring gaskets or packings, right or left couplings, and sweat fittings employing solder having a melting point of less than 1,000°F shall not be used in oil lines. Cast-iron fittings shall not be used.

1402.1.5 Support and protection. Piping shall be substantially supported and protected against physical damage and, where necessary, protected against corrosion. All buried piping shall be protected against corrosion. Drop pipes from shop piping mains to burners are subject to physical damage, and it may be necessary to enclose them in heavier pipe or an equivalent means to safeguard against breakage.

1402.1.6 Expansion and contraction. Proper allowance shall be made for expansion, contraction, jarring and vibration. Pipelines, other than tubing, connected to underground tanks, except straight fill lines and test wells, shall be provided with double swing joints, flexible connectors or otherwise arranged to permit the tanks to settle without impairing the tightness of the pipe connections.

1402.2 Fill and return piping.

1402.2.1 Fill pipe. A fill pipe shall terminate outside of a building at a point not less than 2 feet from any building opening at the same or lower level. A fill pipe shall terminate in a manner designed to minimize spilling when the filling hose is disconnected. Fill openings shall be equipped with a tight metal cover designed to discourage tampering.

1402.2.2 Return pipe. A return line from a burner or pump to a supply tank shall enter the top of the tank.

1402.2.3 Cross connections. Cross connections, except between two supply tanks not exceeding a 660-gallon aggregate capacity permitting gravity flow from one tank to another, shall be prohibited.

1402.2.4 Auxiliary tank filling. An auxiliary tank shall be filled by a pump transferring the oil from the supply tank.

1402.2.5 Auxiliary tank location. An auxiliary tank shall be located at a level above the top of the supply tank from which it is filled.

1402.2.6 Overflow protection. An auxiliary tank shall be provided with an overflow pipe draining to the supply tank and extending into the top of the supply tank not greater than 1 inch. This requirement does not apply to an auxiliary tank specifically listed for use without an overflow pipe.

1402.2.7 Valves prohibited. An overflow pipe from an auxiliary tank and a return line from a burner or pump shall have no valves or obstructions.

1402.3 Supply connections.

1402.3.1 Cross connection. All piping, except the burner supply line from a tank having a capacity of not greater than 660 gallons and the cross connection between two tanks having an aggregate capacity of 550 gallons or less, shall be connected into the top of a supply tank. When two tanks are cross connected, the tops of the tanks shall be on the same horizontal plane.

1402.3.2 Burner supply connection. For a single tank having a capacity of greater than 660 gallons, or for two or more tanks having an aggregate capacity of greater than 660 gallons, the burner supply connection shall be connected into the top of each tank, except as permitted by Subsection 1402.3.6.

1402.3.3 Oil delivery. A transfer pump or an automatic pump shall be used to deliver oil from a supply tank to a burner or to an auxiliary tank. Except as permitted by Subsection 1402.3.6, a transfer pump shall not be connected to a tank having a capacity of greater than 660 gallons, or to two tanks having an aggregate capacity of greater than 660 gallons.

1402.3.4 Supply pressure. The pressure at the oil supply inlet to an appliance shall not be greater than 3 pounds per square inch (psi).

1402.3.5 Pipe slope. Where supply tanks are set below the level of the burner, the oil piping shall be so laid as to pitch toward the supply tank without traps.

1402.3.6 Shutoff valve. For commercial and industrial installations, the oil supply from tanks of any capacity permitted by this Code shall be in accordance with the following:

- (a) The burner supply line shall be connected to an outside, above-ground supply tank at a point below the liquid level, but each such connection shall be provided with an internal or external shutoff valve located as close as practicable to the shell of the tank. External valves and their connection to the tank shall be of steel.
- (b) A transfer pump may be used.

1402.4 Liquid fuel vent piping.

1402.4.1 Installation. Liquid fuel vent pipes shall be so laid as to drain toward one tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage above ground. Vent pipes from tanks shall be connected into one outlet pipe. The outlet pipe shall be at least one pipe size larger than the largest individual vent pipe connected thereto. The point of connection between two or more vent pipes shall not, in any case, be lower than the top of any fill pipe opening. The lower end of a vent pipe shall enter the tank through the top and shall extend into the tank not greater than 1 inch.

1402.4.2 Termination. Liquid fuel pipes shall terminate outside of buildings at a point not less than 2 feet measured vertically or horizontally from any building opening. Outer ends of vent pipes shall terminate in a weatherproof vent cap or fitting, or be provided with a weatherproof hood. All vent caps shall have a minimum free-open area equal to the cross-sectional area of the vent pipe and shall not employ screens finer than No. 4 mesh. Vent pipes shall terminate sufficiently above the ground to avoid being obstructed by snow or ice. Vent pipes from tanks containing heaters shall be extended to a location where oil vapors discharging from the vent will be readily diffused. If the static head within a vent pipe filled with oil exceeds 10 psi, the tank shall be designed for the maximum static head that will be imposed.

1402.4.3 Vent pipes. Liquid fuel vent pipes shall not be cross connected with fill pipes, lines from burners or overflow lines from auxiliary tanks.

1402.5 Pressurized tank feed. Air or other gases shall not be used to pressurize tanks.

1402.6 Oil gauging.

1402.6.1 Level indication. All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with a method of determining the oil level.

1402.6.2 Test wells. Test wells shall not be installed inside buildings. For outside service, they shall be equipped with a tight metal cover designed to discourage tampering.

1402.6.3 Inside tanks. The gauging of inside tanks by means of measuring sticks shall not be permitted. An inside tank provided with fill and vent pipes shall be provided with a device to indicate, either visually or audibly at the fill point, when the oil in the tank has reached a predetermined safe level.

1402.6.4 Gauging devices. Gauging devices, such as liquid level indicators or signals, shall be designed and installed so that oil vapor will not be discharged into a building from the liquid fuel supply system.

1402.6.5 Gauge glass. A tank used in connection with any oil burner shall not be equipped with a glass gauge or any gauge that, when broken, will permit the escape of oil from the tank.

1402.7 Valves.

1402.7.1 Building shutoff. A readily accessible, manual shutoff valve shall be installed at each point where required to properly control the flow of fuel in normal operation, and where required to avoid oil spillage during servicing. The valve shall be installed to close against the supply, and an automatically operated device designed to shut off the oil supply in case of fire in the immediate vicinity of the burner shall be provided.

1402.7.2 Pump relief valve. Where a shutoff valve is installed in the discharge line of an oil pump that is not an integral part of a burner, a pressure relief valve shall be connected into the discharge line between the pump and the shutoff valve and arranged to return surplus oil to the

supply tank or to bypass it around the pump, unless the pump includes an internal bypass.

1402.7.3 Fuel-oil heater relief valve. Any fuel oil line incorporating a heater shall be provided with a relief valve arranged to discharge to the return line when any valve, pump or other device may prevent the release of excessive pressure because of the expansion of the oil when heated.

1402.7.4 Constant level valve. Where oil is supplied to a burner requiring uniform flow by gravity feed, and a constant level valve is not incorporated in the burner assembly, or the oil is not supplied by an automatic pump, a constant level valve shall be installed in the supply line at the gravity tank, or as close thereto as practicable, to ensure the uniform delivery of oil to the burner. The vent opening of such a constant level valve shall be connected by piping or tubing to the outside of the building, unless the constant level valve is provided with an antiflooding device. Vent piping or tubing of constant level valves shall not be connected to tanks or tank vents.

CHAPTER 15

SOLAR SYSTEMS

SECTION 1501 GENERAL

1501.1 Scope. This Chapter includes provisions for the minimum safe requirements for the construction, installation, alteration and repair of all equipment and systems utilizing solar energy intended to provide energy for space heating, cooling, hot water heating, swimming pool heating, or process heating or cooling. Since solar systems are still in the research-and-development stage, this Chapter is not intended to limit design innovations that will not constitute a hazard.

1501.2 Purpose. The purpose of the recommended requirements is to provide for the reasonable protection of the public health and safety, while at the same time encouraging consumers, builders, designers, manufacturers, installers and others to utilize solar-energy technologies, while permitting experimentation and innovation.

1501.3 Existing buildings. Solar-energy systems may be installed in, on or adjacent to existing buildings or appurtenant structures without having the entire building or structure comply as required for new construction, provided the added solar-energy systems, and the affected portions of the existing building, mechanical, plumbing and electrical systems comply with the applicable provisions of these recommended requirements.

1501.4 Existing systems. Existing solar-energy systems shall be permitted to have their existing use continued, provided their use and maintenance is not a hazard to life, health or property. Conditions that endanger life, limb, health or property shall be abated by repair, rehabilitation, demolition or removal in accordance with the provisions of these recommended requirements, the *EPCOT Building Code* or the reference standards set forth in each EPCOT Code.

1501.5 Components. Solar-energy components also serving as building components shall comply with the applicable provisions of the *EPCOT Building Code* and, when connected to heating, ventilating, air-conditioning and plumbing systems, shall also comply with the applicable provisions of this Section.

1501.6 System classification. Solar-heating systems shall be considered supplemental or auxiliary systems, unless designed to provide the total energy requirements as calculated using Chapter 30 of ASHRAE Handbook *HVAC Applications, Solar Energy Utilization for Heating and Cooling*, or other solar-energy utilization data acceptable to the Chief Mechanical Inspector. Solar systems and/or equipment that will not supply the total energy requirements shall have a primary system or equipment with the capacity to provide the additional energy needed in order to ensure 100-percent capacity to satisfy the energy demand.

Exception: Experimental passive and active solar systems, for the purpose of collecting technical data, may be excluded from the total capacity energy requirements

when requested by the designer and approved by the Chief Mechanical Inspector.

SECTION 1502 MAINTENANCE AND IDENTIFICATION

1502.1 General. Solar-energy systems shall be maintained in accordance with Subsection 101.4, unless state or local government statutes or ordinances conflict with the provisions contained therein.

1502.2 Labeling. Materials and equipment shall bear the manufacturer's or installer's label, or otherwise be identifiable, in accordance with appropriate national standards.

SECTION 1503 DESIGN CRITERIA

1503.1 General. The engineering design of passive and active solar systems shall be in accordance with acceptable engineering practice and standards as listed in the applicable codes and standards adopted by the Chief Mechanical Inspector. Where a primary fossil-fuel or electric-energy system with the total capacity to satisfy the energy required is provided, and provisions are made for the protection of life, health and property, then no restrictions shall be placed on the design or capacity of the solar system.

1503.2 Interconnection. When a solar-energy system and an auxiliary-energy system are interconnected, the maximum allowable temperature or pressure of either system shall not be exceeded in either operational or stagnant modes. The interconnections shall not compromise or bypass the required safety devices.

1503.3 Vents and drains. Liquid solar-energy systems shall be capable of being drained and vented, and of being filled without air entrapment.

1503.4 Personnel protection. Solar-energy systems and components that are subject to contact by unauthorized personnel, and are maintained at elevated temperatures, shall be protected with proper safeguards.

1503.5 Pressure relief devices. Adequately sized, listed or approved pressure relief devices shall be provided in pressurized solar-energy systems and subsystems. Where a pressurized system or portion thereof can be isolated by valving, each such isolated system or portion thereof shall have a listed or approved pressure relief valve. The devices shall be set to relieve the pressure at or below the maximum allowable pressure. Such devices shall drain to approved locations and, when connected to the drainage systems, shall be connected in accordance with Subsection 1002.4.

1503.6 Vacuum conditions. Solar-energy systems shall be designed to prevent damage by vacuum conditions, or shall be provided with listed or approved vacuum relief valves.

1503.7 Connection. Those portions of a solar-energy system connected to a potable water supply shall be protected with listed or approved temperature relief devices in accordance with the applicable provisions of Subsection 1002.4.

1503.8 Thermal expansion. Provisions shall be made for thermal expansion at both operating and stagnation temperatures.

1503.9 Freezing. Provisions shall be made to prevent damage from freezing of the heat transfer or storage fluids.

SECTION 1504 ACCESS AND LOCATION

1504.1 General. Solar-energy collectors, controls, dampers, fans, blowers and pumps shall be accessible for inspection, maintenance, repair and replacement.

1504.2 Obstruction of means of egress. No solar-energy system shall be installed in a location that obstructs the means of egress or accessibility to the building or structure for the fire-fighting apparatus as required by the *EPCOT Building Code*.

1504.3 Local laws. Solar-energy systems, equipment or components shall not be installed in violation of existing zoning, fire or nuisance regulations that govern general construction of structures and buildings as provided in the *EPCOT Building Code* or by the Chief Mechanical Inspector. No solar installation shall be made that would create a hazard to the general public, as determined by the Chief Mechanical Inspector.

SECTION 1505 MATERIALS, SPECIFICATIONS AND TESTS

1505.1 General. Materials shall be listed or approved, be of an approved type, and shall be designated for the fluids they are to handle and for their intended use. Materials that may be adversely affected by environmental factors shall be protected in an approved manner.

1505.2 Seals and gaskets. Sealants and gasket materials used in pressurized systems shall be suitable for the combined system pressure and temperature, and for the fluids contained. Seals used in solar systems shall comply with ASTM D3667, ASTM D3771 and ASTM D3832.

1505.3 Heat transfer fluids.

1505.3.1 Flash point. Heat transfer fluids that are hazardous shall not be used in solar systems, except when approved by the Chief Mechanical Inspector. The flash point of heat transfer liquids shall be:

- (a) **Vented inside.** A minimum of 50°F above the design maximum operating temperature and as high as the maximum stagnation temperature of the liquid in the system.
- (b) **Vented outside.** A minimum of 50°F above the design maximum operating temperature and greater than the maximum stagnation temperature minus 200°F of the liquid in the system, provided the col-

lector, collector manifold and manifold relief valve discharge neither directly nor indirectly into the building, and away from open flames and ignition sources.

1505.3.2 Flammable gasses or liquids. A flammable gas or liquid shall not be used as a heat transfer fluid, unless approved by the Chief Mechanical Inspector. The flash point of fluid used in factory or high-hazard occupancies may be lower, subject to the approval of the Chief Mechanical Inspector.

SECTION 1506 COLLECTOR

1506.1 Label. Manufactured collectors shall be labeled with the manufacturer's name, address and types of transfer fluids compatible with the collector design. Listed collectors shall also include the markings required under the terms of the listing. All collectors, including shop and site-built collectors, shall be labeled to indicate the operating fluid, the maximum allowable temperature and pressure, and the direction of fluid flow.

1506.2 Design pressure and temperature. All materials provided in the fluid passages of a collector assembly shall be capable of withstanding the maximum allowable pressure and temperature.

1506.3 Leakage. Where leakage can cause an unsafe electrical condition, the construction of the collector shall provide protection against both the external leakage of the contained fluid from the collector and the internal leakage into the collector from environmental conditions or cleaning operations as performed during intended user maintenance as specified in the manufacturer's installation instructions.

1506.4 Materials. The collector components, which are exposed to the air circulated to occupied spaces, shall be non-combustible or shall have a flame spread rating not exceeding 25 and a smoke-developed rating not exceeding 50, when tested in accordance with ASTM E84.

Exception: When approved smoke detectors are installed in the duct system from the collector that, when activated, stop all airflow through the collector and sound an alarm, materials that meet the requirements of Subsection 1506.5 shall be used. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a 1-foot-long beam of white light by 4 percent or the equivalent.

1506.5 Insulation. Insulating material shall not flame, smolder, glow or smoke when tested in accordance with ASTM C411 at the temperature to which it is exposed in service. In no case shall the test temperature be less than 250°F. Higher outlet air temperatures shall be used when connected to duct materials approved or listed, and installed for higher temperature use.

1506.6 Temperature limitation. The sustained design outlet temperature of collectors handling air circulated to occupied spaces shall not exceed 250°F.

SECTION 1507 THERMAL STORAGE—AIR SYSTEMS

1507.1 General.

1507.1.1 Prohibited toxins. Heat storage media and thermal storage tank materials, including any interior protection coatings, shall not impart toxic elements to air distributed to areas of human occupancy.

1507.1.2 Heat storage material. Rocks and pebbles used as sensible heat storage shall be washed free of fine particulates and organic materials prior to placement in the rock storage bins.

1507.1.3 Storage unit protection. Where storage units are located outside or underground, they shall be adequately protected against the intrusion of water.

1507.2 Materials. Materials exposed to the air passage shall be noncombustible, or shall have a flame spread rating not exceeding 25 and a smoke-developed rating not exceeding 50, when tested in accordance with ASTM E84.

Exception: In one- and two-family dwellings, materials not meeting the criteria of this Subsection shall be used when smoke detectors approved for duct installation are installed that, when actuated, stop all airflow through the storage device and sound an alarm. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a 1-foot-long beam of white light by 4 percent or the equivalent.

SECTION 1508 THERMAL STORAGE—LIQUID SYSTEMS

1508.1 Testing. Pressurized tanks shall be leak tested after installation, except when the tank contains markings to indicate prior testing has been accomplished. If testing is required, the test pressure shall be $1\frac{1}{2}$ times the maximum allowable pressure. Nonpressurized tanks shall be tested visually for leaks by filling.

1508.2 Cross connection. Potable water systems shall be protected from makeup water cross connections to the solar-energy storage system in accordance with the requirements of the *EPCOT Plumbing Code*.

1508.3 Openings. All openings into tanks, except vents, shall be tightly covered and secured in place. Vents shall be screened with corrosion-resistant materials having not less than 20 openings per linear inch, or otherwise protected.

1508.4 Nonpressurized tanks. Nonpressurized tanks connected to a makeup water system shall have overflows directed to an approved point of disposal. Makeup water piping from the potable water systems shall be connected as required in Subsection 1201.4.

1508.5 Drains. The liquid solar-energy storage system shall be capable of being emptied.

1508.6 Shutoff valves. Shutoff valves shall be provided between the supply system, and the cold and hot water storage tanks.

SECTION 1509 THERMAL STORAGE UNITS AND TANKS

1509.1 General.

1509.1.1 Construction. Storage units shall be designed to contain the storage media without structural failure from temperature, pressure or weight.

1509.1.2 Installation. Storage tanks shall be designed for the application, whether for above-ground or below-ground installation.

1509.2 Dissimilar materials. Dissimilar piping materials, which are not compatible and are to be joined together, shall be electrically isolated to prevent electrolytic and/or galvanic destruction.

SECTION 1510 CONTROLS

1510.1 Design conditions. In solar-energy systems, the following conditions must be prevented either by inherent design features or by equipping the system with the necessary controls:

- (a) The addition of energy to the storage media when the temperature of the storage media has reached its maximum allowable temperature.
- (b) Thermosiphoning, which will allow components to be damaged by freezing.
- (c) Heat transfer fluids reaching the maximum allowable temperature of the system in liquid systems. The pressure and temperature relief devices required in Subsections 1503.4 through 1503.6 shall not be considered as controls to satisfy this condition.
- (d) Damage from thermal shock.

Exception: Provisions of this Subsection shall not apply where adequate data is submitted to demonstrate that these conditions will not occur due to the design and location of the system.

1510.2 Shutdown. The solar-energy system shall revert to a safe mode in the event of manual shutdown or power failure.

1510.3 Identification of controls. All switches and controls shall be clearly identified as to function. All warning lights, when provided, shall indicate the abnormal condition. If manual control adjustments are required during normal operation of the solar system, the control system shall be designed to ensure that the safety of the system and the building in which it is installed are not compromised by failure to make those adjustments.

SECTION 1511 DISTRIBUTION

1511.1 Piping materials. Piping materials shall conform to the manufacturer's recommendations and Subsection 1203.1.

1511.2 Fluid velocity. Piping shall be sized to limit the sustained fluid velocity to levels recommended by the pipe manufacturer considering the type of fluid.

1511.3 Joints.

1511.3.1 Approved joints. Joints shall be of a type approved for the piping material being used and the intended use, and shall conform to the manufacturer's recommendations and Subsection 1203.3.

1511.3.2 Dissimilar materials. Joints between dissimilar materials shall conform to the manufacturer's recommendations and the *EPCOT Plumbing Code*.

1511.4 Changes in direction. Changes in the direction of piping shall conform to the manufacturer's recommendations and the *EPCOT Plumbing Code*.

1511.5 Changes in size. Where different sizes of pipe and fittings are to be connected, such connections shall conform to the manufacturer's recommendations and the *EPCOT Plumbing Code*.

1511.6 Support. Piping shall be supported in conformance to the manufacturer's recommendations and Subsection 1203.4.

1511.7 Openings. Pipe openings in walls, floors or ceilings shall be closed and protected in accordance with Subsection 1203.5.

1511.8 Trenching. Trenching adjacent to footing and trenching, bedding, tunneling and backfilling shall be in conformance to the *EPCOT Plumbing Code*.

1511.9 Embedded piping. Pipes embedded in structural concrete shall conform to Subsection 1203.5.

1511.10 Testing. All piping embedded in structural concrete or masonry shall be tested in accordance with the *EPCOT Plumbing Code*. All other piping shall be tested as follows:

- (a) Prior to piping tests, and after all equipment has been installed, the liquid system shall be flushed to remove sediment, dirt, loose scale, etc., as prescribed by the manufacturer. Strainers shall be cleaned or replaced. During the flushing of the system, the collectors may be disconnected or bypassed to prevent the passage of debris through the collector.
- (b) Closed solar-heating system piping, using liquid heat transfer fluids not directly connected to the potable water supply, shall be tested for pressures not less than $1\frac{1}{2}$ times the maximum design operating pressure for a minimum of 15 minutes.
- (c) The portion of the system connected to the domestic water system shall be tested in the following manner: Upon completion of a section or of the entire water supply system, it shall be tested and proved tight under a water pressure not less than the maximum working pressure under which it is to be used. The water used for tests shall be obtained from a potable source. Except for plastic pipe systems, the water test may be substituted by an air test of 50 psi. Test pressures shall be maintained for a minimum period of 15 minutes without the system leaking. The piping being tested shall remain exposed for inspection and shall not leak during the test.
- (d) Open systems shall be tested by filling to overflow.
- (e) Final leak testing shall be at the maximum allowable pressure with the fluid to be used in the system.

- (f) Testing may be waived by the Chief Mechanical Inspector.

SECTION 1512 DRAINAGE

1512.1 General. Solar-energy system piping shall be provided with a method for drainage. If the system is drained through the building drainage system, it shall be through an air gap in accordance with the *EPCOT Plumbing Code*.

1512.2 Protection of drains. Drains serving heat transfer fluids greater than 140°F, or that are toxic or corrosive, shall be protected in accordance with the requirements of the *EPCOT Plumbing Code*.

1512.3 Warning label. Drains in solar systems where high-temperature, high-pressure or hazardous fluids are discharged shall have a warning label. For hazardous fluids, the label shall describe the hazardous properties of the fluid and emergency first aid procedures. Valves regulating such a discharge shall not be readily accessible to unauthorized personnel.

SECTION 1513 HEALTH

1513.1 Potable water supply. Potable water systems shall be protected against contamination in accordance with the *EPCOT Plumbing Code*.

1513.2 Heat exchangers. Heat exchangers used in domestic water-heating systems shall be approved for the use intended. The system shall have adequate protection to ensure that the potability of the supply and distribution water is properly safeguarded as approved by the Chief Mechanical Inspector.

1513.3 Leakage or condensation. Food, drink, or other products manufactured or processed for human or animal consumption shall not be stored, prepared or displayed beneath overhead distribution piping, unless such pipes are protected against leakage or condensation reaching such products as required in Subsection 307.2.4.

SECTION 1514 AIR DISTRIBUTION SYSTEM

1514.1 Installation. Duct systems shall be constructed and installed in accordance with the requirements of Chapter 6.

CHAPTER 16

REFERENCED STANDARDS

This Chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard.

ACCA

Air-Conditioning Contractors of America
2800 Shirlington Road
Suite 300
Arlington, VA 22206
www.acca.org

Standard reference number	Title	Referenced in code section number
Manual D—2011	Residential Duct Systems	602
Manual J—2006	Residential Load Calculation, Eighth Edition	A-102
Manual N—2011	Commercial Load Calculation, Fifth Edition	A-102
Manual Q—1990	Commercial Low-Pressure, Low-Velocity Duct System Design, First Edition	602

ACGIH

American Conference on Governmental Industrial Hygienists
1330 Kemper Meadow Drive
Cincinnati, OH 45240
www.acgih.org

Standard reference number	Title	Referenced in code section number
ACGIH Manual	Industrial Ventilation: A Manual of Recommended Practice for Design, 27th Edition.	Chapter 17

ADC

Air Diffusion Council
1901 North Roselle Road
Suite 800
Schaumburg, IL 60195
www.flexibleduct.org

Standard reference number	Title	Referenced in code section number
	Flexible Duct Performance and Installation Standards, Fifth Edition	602, Appendix B

ANSI

American National Standards Institute
25 West 43rd Street
4th Floor
New York, NY 10036
www.ansi.org

Standard reference number	Title	Referenced in code section number
ASHRAE 15—13	Safety Standard for Refrigeration Systems.	302.3, 1101.2, 1107.2.1, 1107.2.2
ASHRAE 34—13	Designation and Safety Classification of Refrigerants.	1101.7, Table 1102, 1102.1
ASME B31.9—11	Building Services Piping.	Table 1203
AWS A2.4—12	Standard Symbols for Welding, Brazing and Non-Destructive Examination	Chapter 17
AWS A3.0/A3.0M—10	Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying.	Chapter 17

(continued)

REFERENCED STANDARDS

ANSI—continued

→ AWS B1.10/B1.10M—16	Guide for the Non-Destructive Examination of Welds	Chapter 17
→ AWS B2.1/B2.1M—09	Welding Procedure and Performance Qualification	Chapter 17
AWS C5.2—01	Recommended Practices for Plasma Arc Cutting and Gouging	Chapter 17
AWS C5.4—93	Recommended Practices for Stud Welding	Chapter 17
AWS C5.5/C5.5M—03	Recommended Practices for Gas Tungsten Arc Welding	Chapter 17
AWS C5.6—89R	Recommended Practice for Gas Metal Arc Welding	Chapter 17
AWS C5.7—00(R2006)	Recommended Practices for Electro-Gas Welding	Chapter 17
AWS D10.7/D10.7M—08	Guide for the Gas-Shielded Arc Welding of Aluminum and Aluminum-Alloy Pipe	Chapter 17
AWS D10.11/D10.11M—07	Guide for Root-Pass Welding of Pipe without Backing	Chapter 17
B31.1—14	Power and Process Piping Package	Chapter 17
B36.10M—04	Welded and Seamless Wrought-Steel Pipe	1201.4.1, 1402.1.2
B73.1—12	Horizontal End Suction Centrifugal Pumps for Chemical Process	1201.2.1
B77.1—11/B77.1a—12	Passenger Ropeways—Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors—Safety Requirements	Chapter 17
C50.11—65	Synchronous Motors (Withdrawn)	1201.2.2
Z21.13—14	Gas-Fired, Low-Pressure Steam and Hot Water Boilers	1001.2
Z21.59—74	Gas-Fired, High-Pressure Steam and Hot Water Boilers, Second Edition (Withdrawn)	1001.2

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329
www.ashrae.org

Standard reference number	Title	Referenced in code section number
62.1—13	Ventilation for Acceptable Indoor Air Quality	402
ASHRAE—12	Handbook, HVAC Systems and Equipment	302.3, 602
ASHRAE—13	Handbook, Fundamentals	1106.1.1, A-102
ASHRAE—11	Handbook, HVAC Applications, Chapter 30, Solar Energy Utilization	1501.6

ASME

American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016
www.asme.org

Standard reference number	Title	Referenced in code section number
BPVC—2010/2011 addenda	ASME Boiler and Pressure Vessel Code: 07 Edition	1001.2, 1003.2, 1701.3
B1.20.1—1983(R2006)	Pipe Threads	1203.12.1

ASTM

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428
www.astm.org

Standard reference number	Title	Referenced in code section number
→ A53/A53M—12	Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless	Table 1203, Table 1204
→ B42—10	Seamless Copper Pipe, Standard Sizes	1106.2.3, Table 1203
→ B43—09	Seamless Red Brass Pipe, Standard Sizes	1106.2.3, Table 1203
→ B88—09	Seamless Copper Water Tube	1106.2.4, Table 1203, Table 1204
→ B280—08	Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service	1106.2.5
→ B813—10	Liquid and Paste Fluxes for Soldering of Copper and Copper-Alloy Tube	1203.3
→ B828—10	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings	1203.3
C177—13	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus	Appendix B

(continued)

ASTM—continued

C315—07(2011)	Clay Flue Liners and Chimney Pots	Figure 813A
C411—11	Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation605, 1506.5
C518—10	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	Appendix B
D1693—13	Test Method for Environmental Stress-Cracking of Ethylene Plastics	Table 1206.2A
D1785—12	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120	Table 1204
D2104—01	Polyethylene (PE) Plastic Pipe, Schedule 40 (Withdrawn)	Table 1204
D2239—12a	Polyethylene (PE) Plastic Pipe (SDR-PR), Based on Controlled Inside Diameter	Table 1204
D2241—09	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)	Table 1204
D2513—14e1	Thermoplastic Gas Pressure Pipe Tubing and Fittings	Table 1206.2A
D2581—09	Polybutylene (PB) Plastics Molding and Extrusion Materials	Table 1206.2A
D2662—96	Polybutylene (PB) Plastic Tubing (Withdrawn)	Table 1204
D2666—96	Polybutylene (PB) Plastic Tubing (Withdrawn)	Table 1204
D2683—10E1	Socket-Type Polyethylene Fittings for Outside-Diameter-Controlled Polyethylene Pipe and Tubing	Table 1206.2B
D3000—95	Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter (Withdrawn)	Table 1204
D3261—12	Butt Heat-Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing	Table 1206.2B
D3309—96a(2002)	Polybutylene (PB) Plastic Hot and Cold Water Distribution Systems	Table 1203, Table 1204
D3350—14	Polyethylene Plastics Pipe and Fittings Materials	Table 1206.2A
D3667—05(2010)	Rubber Seals Used in Flat-Plate Solar Collectors	1505.2
D3771—03(2007)	Rubber Seals Used in Concentrating Solar Collectors	1505.2
D3832—79(2011)	Rubber Seals Contacting Liquids in Solar Energy Systems	1505.2
E84—13A	Test Method for Surface-Burning Characteristics of Building Materials	202, 307.1, 1506.4, 1507.2
E119—12a	Test Method for Fire Tests of Building Construction Materials	609.2.1, 609.8, 609.9
E136—12	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	202
F714—13	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter	Table 1206.2A

AWS

American Welding Society
550 NW LeJeune Road
Miami, FL 33126
www.aws.org

Standard reference number	Title	Referenced in code section number
D9.1M/D9.1—18	Sheet Metal Welding Code604.1.1.1

CODES

This model code is intended to be utilized in conjunction with the other model codes that are adopted by the jurisdiction.

Standard reference number	Title	Referenced in code section number
	EPCOT Building Code—2018 Edition	101.1, 101.4.2, 102.2, 104.4, 201.3, 202, 301.3.1, 301.4.1, 303.6.1, 303.7.1, 401.4, 403.1, 405.4, 407.2, 504.8, 605.1.8, 608.2.2.1, Table 810, 903.3.6, 904.5.1, 1006.2, 1102.2, 1103.2, 1104.2.1, 1105.4.2, 1201.3.1, 1501.4, 1501.5, 1504.2, 1504.3
	EPCOT Fire Prevention Code—2018 Edition	201.3
	EPCOT Energy Efficiency Code for Building Construction—2018 Edition	A-101
	EPCOT Fuel Gas Code—2018 Edition	101.1, 101.4.4, 102.2, 201.3, 301.6, 801.7, 813.11, 814.1, 904.9.6, 1101.6, 1302, 1303, 1401.2.3
	EPCOT Plumbing Code—2018 Edition	101.1, 101.4.6, 102.2, 105.6, 201.3, 511, 608.1.1, 1001.3, 1101.5, 1201.3.2, 1201.4.1, 1201.4.2, 1203.11, 1508.2, 1511.3.2, 1511.4, 1511.5, 1511.8, 1511.10, 1512.1, 1512.2, 1513.1
M-1	Industrial Ventilation Manual	1701.1
M-2	Aerial Passenger Tramways	1701.1, 1701.3(d)
M-3	Gas Piping	1701.1

(continued)

REFERENCED STANDARDS

CODES—continued

M-4	Power Piping	1701.1
M-5	Welding Standards	1701.1
M-6	Boiler and Pressure Vessel Code, Division 1	1701.1

GAMA

Gas Appliance Manufacturers Association
[Formerly The Hydronics Institute (HYDI)]
2107 Wilson Boulevard
Suite 600
Arlington, VA 22201
www.gamanet.org

Standard reference number	Title	Referenced in code section number
C-30—84	Cooling Load Calculation Guide	A-102
H-22—98	Heat Loss Calculation Guide	A-102

NAIMA

North American Insulation Manufacturers Association
44 Canal Center Plaza
Suite 310
Alexandria, VA 22314
www.naima.org

Standard reference number	Title	Referenced in code section number
AH 116—09	Fibrous Glass Duct Construction Standards	602
AH 124—02	Fibrous Glass Duct Liner Standard, First Edition	602

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169
www.nfpa.org

Standard reference number	Title	Referenced in code section number
12—15	Carbon Dioxide Extinguishing Systems	507.3
13—13	Installation of Sprinkler Systems	507.3
16—15	Installation of Foam-Water Sprinkler and Foam-Water Spray Systems	507.3
17—09	Dry-Chemical Extinguishing Systems	507.3
17A—09	Wet-Chemical Extinguishing Systems	507.3
31—11	Installation of Oil-Burning Equipment	814.2
70—14	National Electrical Code	101.1, 101.4.3, 102.2, 308.1, 403.2, Table 1103A, 1105.6, 1105.7
72—13	National Fire Alarm and Signaling Code	405.1, 609.7.1
82—14	Incinerators Waste- and Linen-Handling Systems and Equipment	601.3, 904.2
90A—15	Installation of Air-Conditioning and Ventilating Systems	302.3
90B—15	Installation of Warm-Air Heating and Air-Conditioning Systems	302.3
91—15	Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids	510.1
96—14	Ventilation Control and Fire Protection of Commercial Cooking Operations	303, 505.1, 507.3
214—11	Water-Cooling Towers	302.3

SMACNA

Sheet Metal and Air-Conditioning Contractors National Association, Inc.
4201 Lafayette Center Drive
Chantilly, VA 20151
www.smacna.org

Standard reference number	Title	Referenced in code section number
SMACNA—10	Fibrous Glass Duct Construction Standards	602
SMACNA/ANSI—05	HVAC Duct Construction Standards—Metal and Flexible—3rd Edition (ANSI)	602



Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

Standard reference number	Title	Referenced in code section number
103—10	Factory-Built Chimneys, Residential Type and Building Heating Appliance—with Revisions through July 2012	803.2, Table 810
127—11	Factory-Built Fireplaces	803.3, 903.1
181—05	Factory-Made Air Ducts and Air Connectors—with Revisions through October 2008	602, 603.2, 608.1.2
181A—13	Closure Systems For Use with Rigid Air Ducts and Air Connectors	602
181B—13	Closure Systems For Use with Flexible Air Ducts and Air Connectors	602
263—11	Fire Test of Building Construction and Materials	609.2.1, 609.8, 609.9
555—06	Fire Dampers—with Revisions through May 2012	202, 609.1.1
555S—99	Smoke Dampers—with Revisions through May 2012	202
737—11	Fireplace Stoves	903.2
910—98	Test Method for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air (Withdrawn)	608.1.2
1482—11	Solid-Fuel Type Room Heaters	903.2
1777—07	Chimney Liners—with Revisions through July 2009	805.2.6, 805.4, 806.4

CHAPTER 17

CERTIFICATION AND TESTING OF SPECIAL EQUIPMENT AND SYSTEMS

SECTION 1701 CRITERIA

1701.1 Scope. The regulations of this Chapter shall apply to electro/mechanical systems, subsystems and/or component parts thereof that are installed and/or used within the District, and are classified as high-pressure, high-temperature, high-risk systems wherein the safety of the public is dependent on the structural integrity and technical reliability of the assembled system and its component parts. Such high-pressure gas systems used to pump, store and transfer natural gas to fuel-reciprocating engines (stationary or mobile types); high-pressure/high-temperature boiler systems used to generate, store, circulate and heat exchange high-temperature liquids or steam; aerial passenger tramways; vehicle-mounted or fixed-station-type elevating and rotating work platforms; functional and technical integrity and reliability is essential to the safety of the public as specified in the US Department of Transportation (DOT), Hazardous Materials Regulation Board as stipulated in *Federal Register* Title 49, and referenced documents and standards: EPCOT Standards M-1, M-2, M-3, M-4, M-5 and M-6.

1701.2 Criteria. The equipment and systems installed under the provisions of this Chapter shall comply with the applicable requirements of the established procedures and the EPCOT Standards referenced herein, and in Chapter 16.

1701.3 Inspection, test and recertification intervals.

- (a) When required by the governing code or standard, all significant component parts of systems and subsystems, i.e., cables, structural members and shapes, castings, piping, pressure vessels, etc., must be supplied with certificates issued by the manufacturer attesting to the metallurgical properties, structural and pressure integrity, and functional reliability of the component, such as ASME *Boiler and Pressure Vessel Code* documents, Underwriters Laboratory test documents, metallurgical reports, etc. These documents, or acceptable copies thereof, must be submitted to the Department of Building and Safety prior to the installation of the system for approval and permanent record administration.
- (b) New systems must be inspected, tested and certified by the Chief Mechanical Inspector for the District or his approved agent for use before being placed into operation, using test procedures approved by the governing standard, rules and regulations. High-pressure gas cylinders shall be tested and recertified at intervals specified by DOT and the Compressed Gas Association, using the test procedures approved by these agencies.
- (c) High-pressure gas piping, transfer and storage systems shall be inspected at six-month intervals. The system will be retested and certified for use after any changes

EPCOT STANDARD	TITLE OF STANDARD and YEAR	
M-1	<i>Industrial Ventilation Manual</i>	ACGIH—78
M-2	<i>Aerial Passenger Tramways</i>	ANSI B77.1—92
M-3	<i>Gas Piping</i>	ANSI B31.1—95
M-4	<i>Power Piping</i>	ANSI B31.1—95
M-5	<i>Welding Standards</i>	ANSI/AWS B1.10—92
		ANSI/AWS B2.1—98
		ANSI/AWS A2.4—98
		ANSI/AWS A3.0—94
		ANSI/AWS C5.2—94
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		ANSI/AWS D10.7—92
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M-6	<i>Boiler and Pressure Vessel Code, Division 1</i>	ASME 1995

to the pipe system, or after partial disassembly of the system to repair or replace component parts; and at rated life interval of the storage cylinder, such as every five years for a DOT-ICC-3, 3A and 3AA cylinder.

- (d) Aerial passenger tramways shall be inspected semi-annually under the direction of the Chief Mechanical Inspector or his assigned agent, by a specialist acceptable to the authority having jurisdiction. The Chief Mechanical Inspector shall cover the requirements of EPCOT Standard M-2. A report shall be filed with the owner of the authority having jurisdiction. Any item not in compliance with EPCOT Standard M-2 shall be noted therein. Any change of system components or modification of the system shall require reinspection before the system is placed back into operation.

APPENDIX A

GUIDELINES FOR ESTIMATING HEAT LOSS AND HEAT GAIN

SECTION A-101 COMPLIANCE

A-101.1 Scope. All heat loss and heat gain design criteria shall comply with the *EPCOT Energy Efficiency Code for Building Construction*®.

SECTION A-102 GUIDELINES TO ACHIEVE THE DESIGN CRITERIA

A-102.1 Estimating heat loss and heat gain. The following methods shall apply when estimating heat loss and heat gain in buildings. Other equivalent methods shall be used, provided approval is granted by the Chief Mechanical Inspector.

- (a) **Residential occupancy.** To estimate heat loss and heat gain in a residential occupancy, ACCA Manual J, ASHRAE *Handbook of Fundamentals*, or HYDI C-30 and HYDI H-21 shall be used.
- (b) **Other than residential occupancy.** To estimate heat loss and heat gain for other than a residential occupancy, ACCA Manual N or ASHRAE *Handbook of Fundamentals* shall be used.

APPENDIX B

PROCEDURES FOR DETERMINING THERMAL RESISTANCE (R) VALUES FOR AIR DISTRIBUTION DUCTS AND PLENUMS

SECTION B-101 COMPLIANCE

B-101.1 Thermal resistance. All duct insulation and factory-made ducts shall be labeled with the thermal resistance (R) value based on the flat section of insulation only, at installed thickness and excluding any air-film resistance.

SECTION B-102 TEST METHOD AND CALCULATION

B-102.1 Methodology. The thermal resistance (R) value shall be determined using the relationship $R = t/k$; where t (inches) is the installed thickness and k (Btu · in/h · ft² · °F) is the measured thermal conductivity at 75°F mean temperature, and at installed thickness when tested in accordance with ASTM C177 or ASTM C518.

- (a) For duct board, duct liner and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
- (b) For duct wrap, installed thickness shall be assumed to be 75 percent (allowing for 25-percent compression) of nominal thickness.
- (c) For factory-made, flexible air ducts, the installed thickness and calculated R -values shall be determined in accordance with Paragraph 3.4 of the ADC *Flexible Duct and Installation Standards*. (See Section 602.)

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EPCOT

PLUMBING CODE 2018 EDITION

AS ADOPTED BY THE
REEDY CREEK IMPROVEMENT DISTRICT

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FOREWORD

The purpose of the *EPCOT Plumbing Code*® is to serve as a comprehensive regulatory document to guide decisions aimed at protecting the public's life, health, safety and welfare in the built environment. This protection is provided through the adoption and enforcement, by state and local governments, of the performance-based provisions contained herein.

The use of performance-based requirements encourages the use of innovative building designs, materials and construction systems, while at the same time recognizing the merits of the more traditional materials and systems. This concept promotes maximum flexibility in building design and construction, as well as assuring a high degree of life safety.

The *EPCOT Plumbing Code* incorporates, by reference, nationally recognized consensus standards for use in judging the performance of materials and systems. This provides for the equal treatment of both innovative and traditional materials and systems, provides for the efficient introduction of new materials into the construction process and assures a high level of consumer protection.

PREFACE

Introduction

Internationally, Code Officials recognize the need for a modern, up-to-date plumbing code addressing the design and installation of plumbing systems through requirements emphasizing performance. The *EPCOT Plumbing Code* is designed to meet these needs through model code regulations that safeguard the public's health and safety in all communities, large and small.

This comprehensive plumbing code establishes minimum regulations for plumbing systems using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new plumbing designs.

Marginal Markings

Solid vertical lines in the margins within the body of this Code indicate a change from the requirements of the 2015 edition, except where a change was minor. Deletion indicators (➡) are provided in the margin where an entire section, paragraph, exception or table has been deleted if the deletion resulted in a change of requirements.

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CHAPTER 1

ADMINISTRATION

SECTION 101 TITLE AND SCOPE

101.1 Title. The provisions in the following Chapters and Sections of this volume, together with the Appendices, shall constitute and be known as “The *EPCOT Plumbing Code*” and hereinafter be referred to as “this Code.”

101.2 Code remedial. This Code is hereby declared to be remedial, and shall be constructed to secure the beneficial interest and purposes thereof, which are health, sanitation, general public safety and welfare, by regulating the installation and maintenance of all plumbing.

101.3 Scope. The provisions of this Code shall apply to every plumbing installation, including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and appurtenances thereto, and when connected to a water or sewage system.

101.4 Maintenance. All plumbing, both existing and new, and all parts thereof, shall be maintained in a safe and sanitary condition. All devices or safeguards that are required by this Code shall be maintained in good working order. The owner, or his designated agent, shall be responsible for the maintenance of plumbing.

101.5 Plumbing installation or maintenance by home owner. Nothing in this Code shall prevent a homeowner from installing or maintaining plumbing within his own property boundaries, provided such plumbing work is done by himself and is used exclusively by him or his family. Such privilege does not convey the right to violate any of the provisions of this Code, nor is it to be construed as exempting any such property owner from obtaining a permit and paying the required fees therefor.

101.6 Abandonment of piping and/or fittings. Abandoned piping and/or fittings shall be removed.

Exception: If it is technically infeasible to remove the pipe/fittings, the pipe/fittings may be abandoned in place at the discretion of the Chief Plumbing Inspector. Abandon in place requires the pipe/fittings to be filled and sealed with grout equal to Class “C” concrete. The grout shall form a solid waterproof plug completely bonded to the pipe, and the pipe shall be permanently labeled as abandoned.

SECTION 102 ORGANIZATION

102.1 Creation of a plumbing division. There is hereby created, in the Department of Building and Safety of the Reedy Creek Improvement District (the District) the Plumbing Inspection Division, which shall be responsible to the Building Official.

102.2 Appointment of Chief Plumbing Inspector. The Building Official, with the concurrence of the director/administration and services, shall appoint a Chief Plumbing Inspector. No person shall be appointed as Chief Plumbing Inspector who has not had at least 10 years experience as a plumbing inspector, journeyman plumber, master plumber, engineer, or as a superintendent, foreman or competent mechanic in charge of plumbing construction. He shall serve under the direction of the Building Official.

102.3 Restriction on employees. No officer or employee connected with the Department of Building and Safety shall be financially interested in the furnishing of labor, material or appliances for the construction, alteration or maintenance of plumbing installations, or in the making of plans or of specifications therefor, unless he is the owner of such building. No such officer or employee shall engage in any work that is inconsistent with his duties or with the interests of the Department.

102.4 Records. The Chief Plumbing Inspector shall keep, or cause to be kept, a record of the business of the Plumbing Inspection Division. The records of the Division shall be open to public inspection at all reasonable times.

SECTION 103 POWERS AND DUTIES OF THE CHIEF PLUMBING INSPECTOR

103.1 Right of entry. The Chief Plumbing Inspector shall enforce the provisions of this Code, and he or his duly authorized representative may enter any building, structure or premises to perform any duty imposed upon him by this Code.

103.2 Stop work orders. Upon notice from the Chief Plumbing Inspector that work on any plumbing installation is being done contrary to the provisions of this Code, or in a dangerous or unsafe manner, such work shall be immediately stopped. Such notice shall be in writing and shall be given to the owner of such property, or to his agent, or to the person doing the work, and shall state the conditions under which work may be resumed. Where any emergency exists, oral notice given by the Chief Plumbing Inspector shall be sufficient.

103.3 Revocation of permits. The Chief Plumbing Inspector may revoke a permit or approval, issued under the provisions of this Code, in case there has been any false statement of misrepresentation as to the material fact in the application of plans on which the permit or approval was based. In all such cases, permit fees shall not be refunded.

103.4 Unsafe installations. All plumbing installations, regardless of type, which are unsanitary or constitute a hazard to human life, health or welfare, are hereby declared illegal and shall be abated by repair and rehabilitation or by demolition.

tion in accordance with the procedure set forth in Section 310 of the *EPCOT Building Code*.

103.5 Requirements not covered by code. Any requirements necessary for the safety, strength or stability of an existing or proposed plumbing installation, or for the safety of the occupants of a building or structure not specifically covered by this Code, shall be determined by the Building Official or the Chief Plumbing Inspector.

103.6 Alternative materials and methods of installations. Alternative plumbing materials and alternative methods of installations shall be approved, and in accordance with the provisions of Section 311 of the *EPCOT Building Code*.

103.7 Liability. Any officer or employee, or member of any board charged with the enforcement of this Code, acting for the local governing body in the discharge of his duties, shall not thereby render himself liable personally and he is hereby relieved from all personal liability for any damage that may occur to persons or property as a result of any act required or permitted in the discharge of his duties. Any suit brought against any officer or employee because of such act performed by him in the enforcement of any provision of this Code shall be defended by the legal department of the District until the final termination of the proceedings.

SECTION 104 APPLICATION FOR PERMIT

104.1 When required. No person, firm or corporation shall connect any plumbing work with any sewer, sanitary or storm, septic tank or sewage disposal system of any kind, or install fixtures or appliances in new or existing systems, structures or premises, or repair or add to any existing plumbing without first applying for and obtaining a separate plumbing permit therefore from the Chief Plumbing Inspector.

104.2 Application form. Application for a permit shall be made in person. The applicant shall furnish information as may be required to complete the application form furnished by the Chief Plumbing Inspector.

104.3 Filing of application form. The applicant shall file an application on forms supplied by the Department of Building and Safety. The application for permit shall provide all information needed for enforcement of this Code.

104.4 Drawings and specifications. Whenever, in the opinion of the Chief Plumbing Inspector, drawings and specifications are needed to show definitely the nature and character of the work for which the application is made, the applicant shall furnish such drawings and specifications. Drawings and specifications shall be drawn to scale and submitted in duplicate. If approved, one set shall be returned to the applicant, marked approved, and one set shall be retained and filed as a permanent record in the office of the Chief Plumbing Inspector. The applicant's approved set shall remain at all times on the job. Such information or drawings and specifications shall be specific, and this Code shall not be cited as a whole or in part, nor shall the term "legal" or its equivalent be issued as a substitute for specific information.

104.5 Examination of drawings. The Chief Plumbing Inspector shall examine or cause to be examined each application for a permit and the drawings and specifications that may be filed therewith, and shall ascertain by such examination whether the plumbing installation indicated and described is in accordance with the requirements of this Code and all other pertinent laws or ordinances.

104.6 Qualification requirements. Prior to engaging in the business of plumbing contracting in the District, a person, firm or corporation shall satisfy the Chief Plumbing Inspector that he is or has in his employ a properly registered or certified master plumber.

SECTION 105 PERMITS

105.1 Action on application.

- (a) If the Chief Plumbing Inspector is satisfied that the work described in an application for permit and the drawings and specifications that may be filed therewith conform to the requirements of this Code and other pertinent laws and ordinances, he shall issue a permit therefore to the applicant.
- (b) If the application for permit and the drawings and specifications that may be filed therewith describe work that does not conform to the requirements of this Code or other pertinent laws or ordinances, the Chief Plumbing Inspector shall not issue a permit, but shall return the drawings to the applicant with his refusal to issue such a permit. Such refusal shall, when requested, be in writing and shall contain the reasons therefore.

105.2 Condition of the permit. The Chief Plumbing Inspector shall act upon an application for a permit with plans as filed, or as amended, without unreasonable or unnecessary delay. A permit issued shall be construed to be a license to proceed with the work and shall not be construed as authority to violate, cancel, alter or set aside any of the provisions of this Code, nor shall such issuance of a permit prevent the Chief Plumbing Inspector from thereafter requiring correction of errors in plans or in construction, or of violations of this Code. Any permit issued shall become invalid unless the work authorized by it shall have been commenced within six months after its issuance, or if the work authorized by such permit is suspended or abandoned for a period of six months after the time the work commenced; provided, that for cause, one or more extensions of time for periods not exceeding 90 days each may be allowed in writing by the Chief Plumbing Inspector.

SECTION 106 FEES

106.1 General. No permit shall be valid until the fees prescribed in this Section shall have been paid; nor shall an amendment to a permit be approved until the additional fees, if required, have been paid. Permit fees shall be based on contract or selling price of installation or alterations, and shall include

electrical, plumbing, mechanical, sprinkler, elevator and owner-furnished equipment.

106.2 Failure to obtain a permit. Any person who commences any work on a plumbing installation before obtaining the necessary permit from the District shall be subject to the penalty prescribed herein.

106.3 Issuance of permits. Upon payment of the total permit fee as determined by using the “Schedule of Building Permit Fees,” as adopted by the Board of Supervisors of the District, the Chief Plumbing Inspector shall issue a plumbing permit.

SECTION 107 INSPECTIONS

107.1 Inspections required. All new plumbing work, and such portions of existing systems as may be affected by new work or any changes, shall be inspected to ensure compliance with all the requirements of this Code, and to ensure that the installation and construction of the plumbing system is in accordance with the approved plans.

107.2 Notification.

- (a) **Advance notice.** It shall be the duty of the permit holder to give reasonable advance notice to the Chief Plumbing Inspector when plumbing work is ready for test or inspection.
- (b) **Permit holder responsibility.** It shall be the duty of the permit holder to make sure that the work will stand the test prescribed before giving the advanced notice.
- (c) **Retesting.** If the Chief Plumbing Inspector finds that the work will not pass the test, the permit holder shall be required to make the necessary corrections and the work shall then be resubmitted for inspection.

107.3 Material and labor for tests. The equipment, material, power and labor necessary for the inspection and test shall be furnished by the plumber.

107.4 Test of drainage and vent systems. All the piping of the plumbing system shall be tested with water or air. After the plumbing fixtures have been set and their traps filled with water, the entire drainage system shall be submitted to final tests. The Chief Plumbing Inspector may require the removal of any cleanouts to ascertain if the pressure has reached all parts of the system.

107.5 Covering the work.

- (a) **Prior to test.** The plumbing system or any part thereof shall not be covered until it has been inspected, tested and approved as prescribed in this Section.
- (b) **Uncovering of work.** If a plumbing system or any part thereof is covered before being inspected, tested and approved as prescribed in this Section, it shall be uncovered upon the direction of the Chief Plumbing Inspector.

107.6 Test of defective plumbing. The drainage system of any building, where there is reason to believe that it has become defective, shall be subject to test or inspection.

SECTION 108 CERTIFICATE OF APPROVAL

108.1 Roughing-in inspection. Upon the satisfactory completion of the roughing-in inspection, approval shall be so noted on the plumbing permit card. This approval shall give the date of the roughing-in inspection and the initials of the Chief Plumbing Inspector.

108.2 Final inspection. The building shall not be occupied prior to the completion of the work on said system and issuance of a Certificate of Occupancy as set forth in Section 308 of the *EPCOT Building Code*.

SECTION 109 VIOLATIONS AND PENALTIES

109.1 Violations. Any person, firm or corporation, or agent, who shall violate a provision of this Code or fail to comply therewith or with any of the provisions thereof, or violate a detailed statement or plan submitted and approved thereunder, shall be guilty of a misdemeanor and shall be subject to the penalty provided in Section 67, Chapter 67-764, Laws of Florida, Special Acts of 1967.

SECTION 110 VALIDITY

110.1 Validity. If any section, subsection, sentence, clause or phrase of this Code is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portion of this Code.

CHAPTER 2

DEFINITIONS

SECTION 201 GENERAL

201.1 Scope. Unless otherwise expressly stated, the following words and terms shall, for the purposes of this Code, have the meanings shown in this Chapter.

201.2 Interchangeability. Words stated in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

201.3 Terms defined in other codes. Where terms are not defined in this Code and are defined in the *EPCOT Building Code* and the *EPCOT Mechanical Code*, such terms shall have the meanings ascribed to them as in those codes.

201.4 Terms not defined. Where terms are not defined through the methods authorized by this Section, such terms shall have ordinarily accepted meanings such as the context implies.

SECTION 202 GENERAL DEFINITIONS

ACCEPTED ENGINEERING PRACTICE. That which conforms to accepted principles, tests or standards of nationally recognized technical or scientific authorities.

ACCESS (TO). That which enables a fixture, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction. (See “Ready access.”)

ACCESS COVER. A removable plate, usually secured by bolts or screws, to permit access to a pipe or pipe fitting for the purposes of inspection, repair or cleaning.

ADAPTER FITTING. An approved connecting device that suitably and properly joins or adjusts pipes and fittings that would not otherwise fit together.

AIR ADMITTANCE VALVE. One-way valve designed to allow air to enter the plumbing drainage system when negative pressures develop in the piping system. The device shall close by gravity and seal the vent terminal at zero differential pressure (no flow conditions) and under positive internal pressures. The purpose of an air admittance valve is to provide a method of allowing air to enter the plumbing drainage system without the use of a vent extended to open air and to prevent sewer gases from escaping into a building.

AIR BREAK (DRAINAGE SYSTEM). A piping arrangement in which a drain from a fixture, appliance or device discharges indirectly into another fixture, receptacle or interceptor at a point below the flood level rim.

AIR GAP (DRAINAGE SYSTEM). The unobstructed vertical distance through the free atmosphere between the outlet of the waste pipe and the flood level rim of the receptacle into which the waste pipe is discharging.

AIR GAP (WATER DISTRIBUTION SYSTEM). The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device, and the flood level rim of the receptacle.

ALTERNATIVE ENGINEERED DESIGN. A plumbing system that performs in accordance with the intent of Chapters 3 through 13, and provides an equivalent level of performance for the protection of public health, safety and welfare. The system design is not specifically regulated by Chapters 3 through 13.

ANCHORS. See “Supports.”

ANTI-SIPHON. A term applied to valves or mechanical devices that eliminate siphonage.

APPROVED. Approved by the Building Official or other authority having jurisdiction.

APPROVED AGENCY. An established and recognized agency approved by the Building Official that is regularly engaged in conducting tests or furnishing inspection services.

AREA DRAIN. A receptacle designed to collect surface or storm water from an open area.

ASPIRATOR. A fitting or device supplied with water or other fluid under positive pressure that passes through an integral orifice or constriction, causing a vacuum. Aspirators are also referred to as suction apparatus, and are similar in operation to an ejector.

BACKFLOW.

Backpressure. Pressure created by any means in the water distribution system that, by being in excess of the pressure in the water supply mains, causes a potential backflow condition.

Backpressure, low head. A pressure less than or equal to 4.33 pounds per square inch or the pressure exerted by a 10-foot column of water.

Backsiphonage. The backflow of potentially contaminated water into the potable water system as a result of the pressure in the potable water system falling below the atmospheric pressure of the plumbing fixtures, pools, tanks or vats connected to the potable water distribution piping.

Backwater valve. A device or valve installed in the building drain or sewer pipe where a sewer is subject to backflow, and that prevents drainage or waste from backing into a low level or fixtures and causing a flooding condition.

Drainage. A reversal of flow in the drainage system.

Water supply system. The flow of water or other liquids, mixtures or substances into the distribution pipes of a potable water supply from any source, except the intended source.

DEFINITIONS

BACKFLOW CONNECTION. Any arrangement whereby backflow is possible.

BACKFLOW PREVENTER. A device or means to prevent backflow.

BALL COCK. A water supply valve, opened or closed by means of a float or similar device, utilized to supply water to a tank. An anti-siphon ball cock contains an anti-siphon device in the form of an approved air gap or vacuum breaker that is an integral part of the ball cock unit and that is positioned on the discharge side of the water supply control valve.

BASE FLOOD ELEVATION. A reference point, determined in accordance with the *EPCOT Building Code*, based on the depth or peak elevation of flooding, including wave height, which has a 1-percent (100-year flood) or greater chance of occurring in any given year.

BATHROOM GROUP. A group of fixtures, including or excluding a bidet, and consisting of a water closet, lavatory, and bathtub or shower. Such fixtures are located together on the same floor level.

BEDPAN STEAMER OR BOILER. A fixture utilized for scalding bedpans or urinals by direct application of steam or boiling water.

BEDPAN WASHER AND STERILIZER. A fixture designed to wash bedpans and to flush the contents into the sanitary drainage system. Included are fixtures of this type that provide for disinfecting utensils by scalding with steam or hot water.

BEDPAN WASHER HOSE. A device supplied with hot and cold water, and located adjacent to a water closet or clinical sink to be utilized for cleansing bedpans.

BRANCH. Any part of the piping system, except a riser, main or stack.

BRANCH INTERVAL. A distance along a soil or waste stack corresponding in general to a story height, but not less than 8 feet, within which the horizontal branches from one floor or story of a structure are connected to the stack.

BRANCH VENT. A vent connecting one or more individual vents with a vent stack or stack vent.

BUILDING. Any structure occupied or intended for supporting or sheltering any occupancy.

BUILDING DRAIN. That part of the lowest piping of a drainage system that receives the discharge from soil, waste and other drainage pipes inside, and that extends 30 inches beyond the walls of the building and conveys the drainage to the building sewer.

Combined. A building drain that conveys both sewage and storm water, or other drainage.

Sanitary. A building drain that conveys sewage only.

Storm. A building drain that conveys storm water or other drainage, but not sewage.

BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this Code, or a duly authorized representative.

BUILDING SEWER. That part of the drainage system that extends from the end of the building drain and conveys the discharge to a public sewer, private sewer, individual sewage disposal system or other point of disposal.

Combined. A building sewer that conveys both sewage and storm water, or other drainage.

Sanitary. A building sewer that conveys sewage only.

Storm. A building sewer that conveys storm water or other drainage, but not sewage.

BUILDING SUBDRAIN. That portion of a drainage system that does not drain by gravity into the building sewer.

BUILDING TRAP. A device, fitting or assembly of fittings installed in the building drain to prevent the circulation of air between the drainage system of the building and the building sewer.

CIRCUIT VENT. A vent that connects to a horizontal drainage branch and vents two traps to a maximum of eight traps or trapped fixtures connected into a battery.

CISTERN. A small covered tank for storing water for a home or farm. Generally, this tank stores rainwater to be utilized for purposes other than in the potable water supply, and such tank is placed underground in most cases.

CLEANOUT. An access opening in the drainage system utilized for the removal of obstructions. Types of cleanouts include a removable plug or cap, or a removable fixture or fixture trap.

CODE. These regulations, subsequent amendments thereto, or any emergency rule or regulation that the administrative authority having jurisdiction has lawfully adopted.

COMBINATION FIXTURE. A fixture combining one sink and laundry tray, or a two- or three-compartment sink or laundry tray in one unit.

COMBINATION WASTE AND VENT SYSTEM. A specially designed system of waste piping embodying the horizontal wet venting of one or more sinks or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain.

COMBINED BUILDING DRAIN. See "Building drain, combined."

COMBINED BUILDING SEWER. See "Building sewer, combined."

COMMON VENT. A vent connecting at the junction of two fixture drains or to a fixture branch, and serving as a vent for both fixtures.

CONCEALED FOULING SURFACE. Any surface of a plumbing fixture that is not readily visible and is not scoured or cleansed with each fixture operation.

CONDUCTOR. A pipe inside the building that conveys storm water from the roof to a storm or combined building drain.

CONSTRUCTION DOCUMENTS. All of the written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a building

permit. The construction drawings shall be drawn to an appropriate scale.

CONTAMINATION. An impairment of the quality of the potable water that creates an actual hazard to the public's health through poisoning, or through the spread of disease by sewage, industrial fluids or waste.

CRITICAL LEVEL (C-L). An elevation (height) reference point that determines the minimum height at which a back-flow preventer or vacuum breaker is installed above the flood level rim of the fixture or receptor served by the device. The C-L is the elevation level below which there is a potential for backflow to occur. If the C-L marking is not indicated on the device, the bottom of the device shall constitute the C-L.

CROSS CONNECTION. Any physical connection or arrangement between two otherwise separate piping systems, one of which contains potable water, and the other either water of unknown or questionable safety, or steam, gas or chemical, whereby there exists the possibility for flow from one system to the other, with the direction of flow depending on the pressure differential between the two systems. (See "Backflow.")

DEAD END. A branch leading from a soil, waste or vent pipe; a building drain; or a building sewer, and terminating at a developed length of 2 feet or more by means of a plug, cap or other closed fitting.

DEPTH OF WATER SEAL. The depth of water that would have to be removed from a full trap before air could pass through the trap.

DEVELOPED LENGTH. The length of a pipeline measured along the centerline of the pipe and fittings.

DISCHARGE PIPE. A pipe that conveys the discharges from plumbing fixtures or appliances.

DRAIN. Any pipe that carries waste water or water-borne wastes in a building drainage system.

DRAINAGE FITTINGS. A special type of fitting or fittings utilized in the drainage system. Drainage fittings are similar to cast-iron fittings, except that instead of having a bell and spigot, drainage fittings are recessed and tapped to eliminate ridges on the inside of the installed pipe.

DRAINAGE FIXTURE UNIT. A measure of the probable discharge into the drainage system by various types of plumbing fixtures. The drainage fixture unit value for a particular fixture depends on its volume rate of drainage discharge, the time duration of a single drainage operation and the average time between successive operations.

DRAINAGE SYSTEM. All of the piping within a public or private premises that conveys sewage, rainwater or other liquid wastes to a point of disposal. A drainage system does not include the mains of public sewer systems, or a private or public sewage treatment or disposal plant.

Building gravity. A drainage system that drains by gravity into the building sewer.

Sanitary. A drainage system that carries sewage and excludes storm, surface and ground water.

Storm. A drainage system that carries rainwater, surface water, condensate, cooling water or similar liquid wastes.

DWELLING UNIT. One or more rooms arranged for the use of one or more persons as a single housekeeping unit; with facilities for cooking, living and sleeping; and with sanitary facilities as required in the *EPCOT Building Code* and complying with the *EPCOT Accessibility Code for Building Construction*.

EFFECTIVE OPENING. The minimum cross-sectional area at the point of water supply discharge, measured or expressed in terms of the diameter of a circle; or, if the opening is not circular, the diameter of a circle of an equivalent cross-sectional area. For faucets and similar fittings, the effective opening shall be measured at the smallest orifice in the fitting body or in the supply piping to the fitting.

EMERGENCY FLOOR DRAIN. A floor drain that does not receive the discharge of any drain or indirect waste pipe, and that protects against damage from accidental spills, fixture overflows and leakage.

ESSENTIALLY NONTOXIC TRANSFER FLUIDS. Fluids having a Gosselin rating of 1, including propylene glycol; mineral oil; polydimethylsiloxane; hydrochlorofluorocarbon, chlorofluorocarbon and hydrofluorocarbon refrigerants; and Food and Drug Administration-approved boiler water additives for steam boilers.

ESSENTIALLY TOXIC TRANSFER FLUIDS. Soil, waste, or graywater and fluids having a Gosselin rating of 2 or more, including ethylene glycol, hydrocarbon oils, ammonia refrigerants and hydrazine.

EXISTING INSTALLATIONS. Any plumbing system regulated by this Code that was legally installed prior to the effective date of this Code, or for which a permit to install has been issued.

FAUCET. The valve end of a water pipe by means of which water is drawn from or held within the pipe.

FIXTURE. See "Plumbing fixture."

FIXTURE BRANCH. A drain serving two or more fixtures that discharges to another drain or a stack.

FIXTURE DRAIN. The drain from the trap of a fixture to a junction with any other drain pipe.

FIXTURE FITTING.

Supply fitting. A fitting that controls the volume and/or directional flow of water, and is either attached to or accessible from a fixture, or is used with an open or atmospheric discharge.

Waste fitting. Combination of components that conveys the sanitary waste from the outlet of a fixture to the connection to the sanitary drainage system.

FIXTURE SUPPLY. The water supply pipe connecting a fixture to a branch water supply pipe or directly to a main water supply pipe.

FLOOD LEVEL RIM. The edge of the receptacle from which water overflows.

DEFINITIONS

FLOOD ZONES.

Flood-hazard zone (A Zone). Areas that have been determined to be prone to flooding, but not subject to high-velocity waters or wave action.

High-hazard zone (V Zone). Areas of tidal influence that have been determined to be subject to wave heights in excess of 3 feet or subject to high-velocity wave run-up or wave-induced erosion.

FLOW PRESSURE. The pressure in the water supply pipe near the faucet or water outlet while the faucet or water outlet is wide open and flowing.

FLUSH TANK. A tank designed with a ball cock and flush valve to flush the contents of the bowl or usable portion of the fixture.

FLUSHOMETER TANK. A device integrated within an air accumulator vessel that is designed to discharge a predetermined quantity of water to fixtures for flushing purposes.

FLUSHOMETER VALVE. A valve attached to a pressurized water supply pipe and so designed that, when activated, it opens the line for direct flow into the fixture at a rate and quantity to operate the fixture properly, and then gradually closes to reseal fixture traps and avoid water hammer.

GREASE INTERCEPTOR. An interceptor whose rated flow exceeds 50 gallons per minute (gpm) and is located outside the building.

GREASE-LADEN WASTE. Effluent discharge that is produced from food processing, food preparation or other source where grease, fats and oils enter automatic dishwasher pre-rinse stations, sinks or other appurtenances.

GREASE TRAP. An interceptor whose rated flow is 50 gpm or less and is located inside the building.

HANGERS. See “Supports.”

HORIZONTAL BRANCH DRAIN. A drainage branch pipe extending laterally from a soil or waste stack, or building drain, with or without vertical sections or branches, that receives the discharge from two or more fixture drains or branches and conducts the discharge to the soil or waste stack, or to the building drain.

HORIZONTAL PIPE. Any pipe or fitting that makes an angle of less than 45 degrees with the horizontal.

HOT WATER. Water at a temperature greater than or equal to 110°F.

HOUSE TRAP. See “Building trap.”

INDIRECT WASTE PIPE. A waste pipe that does not connect directly with the drainage system, but that discharges into the drainage system through an air break or air gap into a trap, fixture, receptor or interceptor.

INDIVIDUAL SEWAGE DISPOSAL SYSTEM. A system for disposal of domestic sewage by means of a septic tank, cesspool or mechanical treatment, designed for utilization apart from a public sewer to serve a single establishment or building.

INDIVIDUAL VENT. A pipe installed to vent a fixture trap and connect with the vent system above the fixture served or terminate in the open air.

INDIVIDUAL WATER SUPPLY. A water supply, except an approved public water supply that serves one or more families.

INTERCEPTOR. A device designed and installed to separate and retain for removal, by automatic or manual means, deleterious, hazardous or undesirable matter from normal wastes, while permitting normal sewage or wastes to discharge into the drainage system by gravity.

JOINT.

Expansion. A loop, return bend or return offset that provides for the expansion and contraction in a piping system and is utilized in tall buildings, or where there is a rapid change of temperature, such as power plants, steam rooms and similar occupancies.

Flexible. Any joint between two pipes that permits one pipe to be deflected or moved without movement or deflection of the other pipe.

Mechanical. See “Mechanical joint.”

Slip. A type of joint made by means of a washer or a special type of packing compound in which one pipe is slipped into the end of an adjacent pipe.

LABELED. Equipment, devices, fixtures or materials bearing the label of an approved agency.

LEADER. An exterior drainage pipe for conveying storm water from roof or gutter drains to an approved means of disposal.

LEAD-FREE PIPE AND FITTINGS. Containing not more than 8.0 percent lead.

LEAD-FREE SOLDER AND FLUX. Containing not more than 0.2 percent lead.

LOCAL VENT STACK. A vertical pipe to which connections are made from the fixture side of traps, and through which vapor or foul air is removed from the fixture or device utilized on bedpan washers.

MACERATING TOILET SYSTEMS. An assembly consisting of a water closet and sump with a macerating pump that is designed to collect, grind and pump wastes from the water closet and up to two other fixtures connected to the sump.

MAIN. The principal pipe artery to which branches are connected.

MAIN VENT. The principal artery of the venting system to which the vent branches may be connected.

MANIFOLD. See “Plumbing appurtenance.”

MECHANICAL JOINT. A connection between pipes, fittings, or pipes and fittings, is not screwed, caulked, threaded, soldered, solvent cemented, brazed or welded. A joint in which compression is applied along the centerline of the pieces being joined. In some applications, the joint is part of a coupling, fitting or adapter.

MEDICAL GAS SYSTEM. The complete system to convey medical gases for direct patient application from central supply systems (bulk tanks, manifolds and medical air compressors) with pressure and operating controls, alarm warning systems, and related components, and extending to station outlet valves at patient use points.

MEDICAL VACUUM SYSTEMS. A system consisting of central-vacuum-producing equipment with pressure and operating controls, shutoff valves, alarm-warning systems, gauges and a network of piping extending to and terminating with suitable station inlets at locations where patient suction may be required.

NIGHTCLUB. An occupancy that contains some or all of the following:

1. Low lighting levels.
2. Entertainment by a live band or recorded music generating above-normal sound levels.
3. Later-than-average operating hours.
4. Tables and seating arranged or positioned so as to create ill-defined aisles.
5. A specific area designated for dancing.
6. Service facilities for alcoholic beverages and food.
7. High occupant load density.

NONPOTABLE WATER. Water not safe for drinking or personal or culinary utilization.

NUISANCE. Public nuisance as known as common law or in equity jurisprudence; whatever is dangerous to human life or detrimental to health; whatever structure or premises is not sufficiently ventilated, sewerred, drained, cleaned or lighted, with respect to its intended occupancy; and whatever renders the air or human food or drink, or water supply, unwholesome.

OCCUPANCY. The purpose for which a building or portion thereof is utilized or occupied.

OFFSET. A combination of approved bends that makes two changes in direction bringing one section of the pipe out of line but into a line parallel with the other section.

OPEN AIR. Outside the structure.

PLUMBING. The practice, materials and fixtures utilized in the installation, maintenance, extension and alteration of all piping, fixtures, plumbing appliances and plumbing appurtenances, within or adjacent to any structure, in connection with sanitary drainage or storm drainage facilities; venting systems; and public or private water supply systems.

Not included in this definition are installations of chilled water piping in connection with refrigeration, process and comfort cooling; hot water piping in connection with building heating; and piping for fire protection systems.

PLUMBING APPLIANCE. Any one of a special class of plumbing fixtures intended to perform a special function. Included are fixtures having the operation or control dependent on one or more energized components, such as motors, controls, heating elements, or pressure- or temperature-sensing elements.

Such fixtures are manually adjusted or controlled by the owner or operator, or are operated automatically through one or more of the following actions: a time cycle, a temperature range, a pressure range, a measured volume or weight.

PLUMBING APPURTENANCE. A manufactured device, prefabricated assembly or an on-the-job assembly of component parts that is an adjunct to the basic piping system and plumbing fixtures. An appurtenance demands no additional water supply and does not add any discharge load to a fixture or the drainage system.

PLUMBING FIXTURE. A receptacle or device that is either permanently or temporarily connected to the water distribution system of the premises and demands a supply of water therefrom; discharges waste water, liquid-borne waste materials or sewage either directly or indirectly to the drainage system of the premises; or requires both a water supply connection and a discharge to the drainage system of the premises.

PLUMBING SYSTEM. Includes the water supply and distribution pipes; plumbing fixtures and traps; water-treating or water-using equipment; soil, waste and vent pipes; and sanitary and storm sewers, and building drains, in addition to their respective connections, devices and appurtenances within a structure or premises.

POLLUTION. An impairment of the quality of the potable water to a degree that does not create a hazard to the public health, but that does adversely and unreasonably affect the aesthetic qualities of such potable waters for domestic use.

POTABLE WATER. Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects, and conforming in bacteriological and chemical quality to the requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.

PRIVATE. In the classification of plumbing fixtures, “private” applies to fixtures in residences and apartments, and to fixtures in nonpublic toilet rooms of hotels and motels, and similar installations in buildings where the plumbing fixtures are intended for utilization by a family or an individual.

PUBLIC OR PUBLIC UTILIZATION. In the classification of plumbing fixtures, “public” applies to fixtures in general toilet rooms of schools, gymnasiums, hotels, airports, bus and railroad stations, public buildings, bars, public comfort stations, office buildings, stadiums, stores, restaurants and other installations where a number of fixtures are installed so that their utilization is similarly unrestricted.

PUBLIC WATER MAIN. A water supply pipe for public utilization controlled by public authority.

QUICK-CLOSING VALVE. A valve or faucet that closes automatically when released manually or that is controlled by a mechanical means for fast-action closing.

READY ACCESS. That which enables a fixture, appliance or equipment to be directly reached without requiring the removal or movement of any panel, door or similar obstruction, and without the use of a portable ladder, step stool or similar device.

DEFINITIONS

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER. A backflow prevention device consisting of two independently acting check valves, internally force-loaded to a normally closed position and separated by an intermediate chamber (or zone) in which there is an automatic relief means of venting to atmosphere, internally loaded to a normally open position between two tightly closing shutoff valves, and with means for testing for tightness of the checks and opening of relief means.

REGISTERED DESIGN PROFESSIONAL. An architect or engineer registered or licensed to practice professional architecture or engineering as defined by the statutory requirements of the professional registration laws of the state in which the project is to be constructed.

RELIEF VALVE.

Pressure relief valve. A pressure-actuated valve held closed by a spring or other means and designed to relieve pressure automatically at the pressure at which such valve is set.

Temperature and pressure relief valve. A combination relief valve designed to function as both a temperature relief and pressure relief valve.

Temperature relief valve. A temperature-actuated valve designed to discharge automatically at the temperature at which such valve is set.

RELIEF VENT. A vent whose primary function is to provide the circulation of air between drainage and vent systems.

RIM. An unobstructed open edge of a fixture.

RISER. See “Water pipe, riser.”

ROOF DRAIN. A drain installed to receive water collecting on the surface of a roof and to discharge such water into a leader or conductor.

ROUGH-IN. Parts of the plumbing system that are installed prior to the installation of fixtures. This includes drainage, water supply, vent piping and the necessary fixture supports, and any fixtures that are built into the structure.

SELF-CLOSING FAUCET. A faucet containing a valve that automatically closes upon deactivation of the opening means.

SEPARATOR. See “Interceptor.”

SEWAGE. Any liquid waste containing animal or vegetable matter in suspension or solution, including liquids containing chemicals in solution.

SEWAGE EJECTORS. A device for lifting sewage by entraining the sewage in a high-velocity jet of steam, air or water.

SEWER.

Building sewer. See “Building sewer.”

Public sewer. A common sewer directly controlled by public authority.

Sanitary sewer. A sewer that carries sewage and excludes storm, surface and ground water.

Storm sewer. A sewer that conveys rainwater, surface water, condensate, cooling water or similar liquid wastes.

SLOPE. The fall (pitch) of a line of pipe in reference to a horizontal plane. In drainage, the slope is expressed as the fall in units vertical per units horizontal (percent) for a length of pipe.

SOIL PIPE. A pipe that conveys sewage containing fecal matter to the building drain or building sewer.

SPILLPROOF VACUUM BREAKER. An assembly consisting of one check valve, force-loaded closed, and an air inlet vent valve, force-loaded open to atmosphere, positioned downstream of the check valve, and located between and including two tightly closing shutoff valves and a test cock.

STACK. A general term for any vertical line of soil, waste, vent or inside conductor piping that extends through at least one story with or without offsets.

STACK VENT. The extension of a soil or waste stack above the highest horizontal drain connected to the stack.

STACK VENTING. A method of venting a fixture or fixtures through the soil or waste stack.

STERILIZER.

Boiling type. A boiling-type sterilizer is a fixture of a non-pressure type utilized for boiling instruments, utensils or other equipment for disinfection. These devices are portable or are connected to the plumbing system.

Instrument. A device for the sterilization of various instruments.

Pressure (autoclave). A pressure vessel fixture designed to utilize steam under pressure for sterilizing.

Pressure instrument washer sterilizer. A pressure instrument washer sterilizer is a pressure vessel fixture designed to both wash and sterilize instruments during the operating cycle of the fixture.

Utensil. A device for the sterilization of utensils as utilized in health care services.

Water. A water sterilizer is a device for sterilizing water and storing sterile water.

STERILIZER VENT. A separate pipe or stack, indirectly connected to the building drainage system at the lower terminal that receives the vapors from nonpressure sterilizers or the exhaust vapors from pressure sterilizers, and conducts the vapors directly to the open air. Also called vapor, steam, atmospheric or exhaust vent.

STORM DRAIN. See “Drainage system, storm.”

STRUCTURE. That which is built or constructed, or a portion thereof.

SUBSOIL DRAIN. A drain that collects subsurface water or seepage water and conveys such water to a place of disposal.

SUMP. A tank or pit that receives sewage or liquid waste located below the normal grade of the gravity system, and that must be emptied by mechanical means.

SUMP PUMP. An automatic water pump powered by an electric motor for the removal of drainage, except raw sewage, from a sump, pit or low point.

SUMP VENT. A vent from pneumatic sewage ejectors or similar equipment that terminates separately to the open air.

SUPPORTS. Devices for supporting and securing pipe, fixtures and equipment.

SWIMMING POOL. Any structure, basin, chamber or tank containing an artificial body of water for swimming, diving or recreational bathing having a depth of 2 feet or more at any point.

TEMPERED WATER. Water ranging in temperature from 85°F to 110°F.

THIRD-PARTY CERTIFICATION AGENCY. An approved agency operating a product or material certification system that incorporates initial product testing, assessment and surveillance of a manufacturer's quality control system.

THIRD-PARTY CERTIFIED. Certification obtained by the manufacturer indicating that the function and performance characteristics of a product or material have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification is in the form of identification in accordance with the requirements of the third-party certification agency.

THIRD-PARTY TESTED. Procedure by which an approved testing laboratory provides documentation that a product, material or system conforms to specified requirements.

TRAP. A fitting or device that provides a liquid seal to prevent the emission of sewer gases without materially affecting the flow of sewage or waste water through the trap.

TRAP SEAL. The vertical distance between the weir and the top of the dip of the trap.

UNSTABLE GROUND. Earth that does not provide a uniform bearing for the barrel of the sewer pipe between the joints at the bottom of the pipe trench.

VACUUM. Any pressure less than that exerted by the atmosphere.

VACUUM BREAKER. A type of backflow preventer installed on openings subject to normal atmospheric pressure that prevents backflow by admitting atmospheric pressure through ports to the discharge side of the device.

VENT PIPE. See "Vent system."

VENT STACK. A vertical vent pipe installed primarily for the purpose of providing the circulation of air to and from any part of the drainage system.

VENT SYSTEM. A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and backpressure.

VERTICAL PIPE. Any pipe or fitting that makes an angle of 45 degrees or more with the horizontal.

WALL-HUNG WATER CLOSET. A wall-mounted water closet installed in such a way that the fixture does not touch the floor.

WASTE. The discharge from any fixture, appliance, area or appurtenance that does not contain fecal matter.

WASTE PIPE. A pipe that conveys only waste.

WATER-HAMMER ARRESTOR. A device utilized to absorb the pressure surge (water hammer) that occurs when water flow is suddenly stopped in a water supply system.

WATER HEATER. Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system.

WATER MAIN. A water supply pipe or system of pipes, installed and maintained by a city, township, county, public utility company or other public entity, on public property, in the street or in an approved dedicated easement of public or community use.

WATER OUTLET. A discharge opening through which water is supplied to a fixture, into the atmosphere (except into an open tank that is part of the water supply system), to a boiler or heating system, or to any devices or equipment requiring water to operate, but which is not part of the plumbing system.

WATER PIPE.

Riser. A water supply pipe that extends one full story or more to convey water to branches or a group of fixtures.

Water distribution pipe. A pipe within the structure or on the premises that conveys water from the water service pipe or the meter, when the meter is at the structure, to the points of utilization.

Water service pipe. The pipe from the water main or other source of potable water supply, or from the meter, when the meter is at the public right-of-way, to the water distribution system of the building served.

WATER SUPPLY SYSTEM. The water service pipe, water distribution pipes, and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to, the structure or premises.

WELL.

Bored. A well constructed by boring a hole in the ground with an auger and installing a casing.

Drilled. A well constructed by making a hole in the ground with a drilling machine of any type and installing casing and screen.

Driven. A well constructed by driving a pipe in the ground. The drive pipe is usually fitted with a well point and screen.

Dug. A well constructed by excavating a large diameter shaft and installing a casing.

WHIRLPOOL BATHTUB. A plumbing appliance consisting of a bathtub fixture that is equipped and fitted with a circulating piping system designed to accept, circulate and discharge bathtub water upon each use.

YOKE VENT. A pipe connecting upward from a soil or waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.

CHAPTER 3

GENERAL REGULATIONS

SECTION 301 GENERAL

301.1 Scope. The provisions of this Chapter shall govern the general regulations regarding the installation of plumbing not specific to other chapters.

301.2 System installation. Plumbing shall be installed with due regard to the preservation of the strength of structural members, and the prevention of damage to walls and other surfaces through fixture usage.

301.3 Connections to drainage system. All plumbing fixtures, drains, appurtenances and appliances used to receive or discharge liquid wastes or sewage shall be connected properly to the drainage system of the building or premises in accordance with the requirements of this Code. This Subsection shall not be construed to prevent indirect waste systems provided for in Chapter 8.

Exception: Bathtubs, showers, lavatories, clothes washers and laundry sinks shall not be required to discharge to the sanitary drainage system where such fixtures discharge to an approved graywater recycling system that meets the requirements of Appendix C.

301.4 Connections to water supply. Every plumbing fixture, device or appliance requiring or using water for its proper operation shall be directly or indirectly connected to the water supply system in accordance with the provisions of this Code.

301.5 Pipe, tube and fitting sizes. Unless otherwise specified, the pipe, tube and fitting sizes specified in this Code are expressed in nominal or standard sizes as designated in the referenced material standards.

301.6 Prohibited locations. Plumbing systems shall not be located in an elevator shaft or an elevator equipment room.

Exception: Floor drains, sumps and sump pumps shall be permitted at the base of the shaft provided they are indirectly connected to the plumbing system.

301.7 System maintenance. Plumbing systems, including fixtures, shall be maintained in a sanitary condition and in proper working order.

301.8 Existing buildings. In existing buildings or premises in which plumbing installations are to be altered, repaired or renovated, necessary deviations from the provisions of this Code may be permitted, provided such deviations conform to the intent of this Code and are approved, in writing, by the Chief Plumbing Inspector.

301.9 Health or safety. Wherever compliance with all of the provisions of this Code fails to eliminate or alleviate a nuisance, which may involve health or safety hazards, the owner or his agent shall install such additional plumbing or drainage

equipment or make modifications as may be necessary to abate such nuisance.

301.10 Used equipment. It shall be unlawful to install used equipment or material for plumbing installations unless it complies with the minimum standards set forth in this Code and is approved by the Chief Plumbing Inspector.

301.11 Condemned equipment. Any plumbing equipment condemned by the Chief Plumbing Inspector because of wear, damage, defects or sanitary hazards shall not be reused for plumbing purposes.

301.12 Conflicts. In instances where conflicts occur between this Code and the manufacturer's installation instructions, the more restrictive provisions shall apply unless the more restrictive requirements violate or void the listing of the product.

SECTION 302 EXCLUSION OF MATERIALS DETRIMENTAL TO THE SEWER SYSTEM

302.1 Detrimental or dangerous materials. Ashes, cinders or rags; flammable, poisonous or explosive liquids or gases; oil, grease or any other insoluble material capable of obstructing, damaging or overloading the building drainage or sewer system, or capable of interfering with the normal operation of the sewage treatment processes, shall not be deposited, by any means, into such systems.

302.2 Industrial wastes. Waste products from manufacturing or industrial operations shall not be introduced into the public sewer until it has been determined by the Building Official or other authority having jurisdiction that the introduction thereof will not damage the public sewer system or interfere with the functioning of the sewage treatment plant.

SECTION 303 MATERIALS

303.1 Identification. Each length of pipe and each pipe fitting, trap, fixture, material and device utilized in a plumbing system shall bear the identification of the manufacturer and any markings required by the applicable approved standard.

303.2 Installation of materials. All materials used shall be installed in strict accordance with the standards under which the materials are accepted and approved. In the absence of such installation procedures, the manufacturer's installation instructions shall be followed. Where the requirement of referenced standards or manufacturer's installation instructions do not conform to minimum provisions of this Code, the provisions of this Code shall apply.

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303.3 Plastic pipe, fittings and components. All plastic pipe, fittings and components shall be third-party certified as conforming to NSF 14.

303.4 Third-party certification. All plumbing products and materials shall be listed by a third-party certification agency as complying with the referenced standards. Products and materials shall be identified in accordance with Subsection 303.1.

SECTION 304 RODENTPROOFING

304.1 General. Plumbing systems shall be designed and installed in accordance with Subsections 304.2 through 304.4 to prevent rodents from entering structures.

304.2 Strainer plates. All strainer plates on drain inlets shall be designed and installed so that all openings are not greater than $\frac{1}{2}$ inch in least dimension.

304.3 Meter boxes. Meter boxes shall be constructed in such a manner that rodents are prevented from entering a structure by way of the water service pipes connecting the meter box and structure.

304.4 Openings for pipes. In or on structures where openings have been made in walls, floors or ceilings for the passage of pipes, such openings shall be closed and protected by the installation of approved metal collars that are securely fastened to the adjoining structure.

SECTION 305 PROTECTION OF PIPES AND PLUMBING SYSTEM COMPONENTS

305.1 Corrosion. Pipes passing through concrete or cinder walls and floors, or other corrosive material, shall be protected against external corrosion by a protective sheathing or wrapping, or other means, that will withstand any reaction from lime and acid of concrete, cinder or other corrosive material. Sheathing or wrapping shall allow for expansion and contraction of piping to prevent any rubbing action. Minimum wall thickness of material shall be 0.025 inch.

Exception: Sleeving is not required for installation of chlorinated polyvinyl chloride (CPVC) pipe into concrete or similar material.

305.2 Stress and strain. Piping in a plumbing system shall be installed so as to prevent strains and stresses that exceed the structural strength of the pipe. Where necessary, provisions shall be made to protect piping from damage resulting from expansion, contraction and structural settlement.

305.3 Pipes through or under footings or foundation walls. Any pipe that passes under a footing or through a foundation wall shall be provided with a relieving arch, or a steel pipe sleeve of Schedule 40 pipe built into the foundation wall. Such sleeve shall be two pipe sizes greater than the pipe passing through the wall.

305.4 Freezing. A water, soil or waste pipe shall not be installed outside of a building, in attics or crawl spaces, concealed in outside walls, or in any other place subjected to freezing temperatures unless adequate provision is made to protect them from freezing by insulation or heat, or both.

Water service pipe shall be installed not less than 12 inches deep or less than 6 inches below the frost line.

305.4.1 Sewer depth. Building sewers that connect to private sewage disposal systems shall be a minimum of 12 inches below finished grade at the point of septic tank connection. Building sewers shall be a minimum of 18 inches below grade.

305.4.2 Exterior utilities. Exterior building storm sewer, domestic water service, compressed air and gas [natural or liquefied petroleum (LP)] shall be a minimum of 18 inches below finished grade.

305.5 Waterproofing of openings. Joints at the roof, around vent pipes, shall be made water tight by the use of lead, copper, galvanized steel, aluminum, plastic or other approved flashings or flashing material. Exterior wall openings shall be made water tight.

305.6 Protection against physical damage. In concealed locations where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than $1\frac{1}{2}$ inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of $\frac{1}{16}$ -inch-thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.

305.7 Protection of components of plumbing system. Components of a plumbing system installed along alleyways, driveways, parking garages or other locations exposed to damage shall be recessed into the wall or otherwise protected in an approved manner.

SECTION 306 TRENCHING, EXCAVATION AND BACKFILL

306.1 Support of piping. Buried piping shall be supported throughout its entire length.

306.2 Trenching and bedding. Where trenches are excavated such that the bottom of the trench forms the bed for the pipe, solid and continuous load-bearing support shall be provided between joints. Bell holes, hub holes and coupling holes shall be provided at points where the pipe is joined. Such pipe shall not be supported on blocks to grade. In instances where the materials' manufacturer's installation instructions are more restrictive than those prescribed by this Code, the material shall be installed in accordance with the more restrictive requirement.

306.2.1 Overexcavation. Where trenches are excavated below the installation level of the pipe such that the bottom of the trench does not form the bed for the pipe, the trench shall be backfilled to the installation level of the bottom of the pipe with sand or fine gravel placed in layers of 6 inches maximum depth and such backfill shall be compacted after each placement.

306.2.2 Rock removal. Where rock is encountered in trenching, the rock shall be removed to a minimum of 3 inches below the installation level of the bottom of the pipe, and the trench shall be backfilled to the installation

level of the bottom of the pipe with sand tamped in place so as to provide uniform load-bearing support for the pipe between joints. The pipe, including the joints, shall not rest on rock at any point.

306.2.3 Soft Load-bearing materials. If soft materials of poor load-bearing qualities are found at the bottom of the trench, stabilization shall be achieved by overexcavating a minimum of two pipe diameters and backfilling to the installation level of the bottom of the pipe with fine gravel, crushed stone or a concrete foundation. The concrete foundation shall be bedded with sand tamped in place so as to provide uniform load-bearing support for the pipe between joints.

306.3 Backfilling. Loose earth, free from rocks, broken concrete, frozen chunks and other rubble, shall be placed in the trench in 6-inch layers and tamped in place. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the materials manufacturer's installation instructions are more restrictive than those prescribed by this Code, the material shall be installed in accordance with the more restrictive requirement.

306.4 Tunneling. Where pipe is to be installed by tunneling, jacking or a combination of both, the pipe shall be protected from damage during installation and from subsequent uneven loading. Where earth tunnels are used, adequate supporting structures shall be provided to prevent future settling or caving.

306.5 Open trenches. All excavating required to be made for the installation of a building drainage system, or any part thereof within the walls of a building, shall be open trench work and shall be kept open until the piping has been inspected, tested and accepted.

SECTION 307 STRUCTURAL SAFETY

307.1 General. In the process of installing or repairing any part of a plumbing and drainage installation, the finished floors, walls, ceilings, tile work or any other part of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the *EPCOT Building Code*.

307.2 Cutting, notching or bored holes. A framing member shall not be cut, notched or bored in excess of the limitations specified in the *EPCOT Building Code*.

307.3 Penetrations of floor-ceiling assemblies and fire-resistance-rated assemblies. Penetrations of floor-ceiling assemblies and assemblies required to have a fire-resistance rating shall be protected in accordance with the *EPCOT Building Code*.

307.4 Trench location. Trenches installed parallel to footings shall not extend below the 45-degree bearing plane of the footing or wall.

SECTION 308 PIPING SUPPORT

308.1 General. All plumbing piping shall be supported in accordance with this Section.

308.2 Piping seismic supports. Where earthquake loads are applicable in accordance with the *EPCOT Building Code*, plumbing piping supports shall be designed and installed for the seismic forces in accordance with the *EPCOT Building Code*.

308.3 Materials. Hangers, anchors and supports shall carry the piping and the contents of the piping. Hangers and strapping material shall be of approved material that will not promote galvanic action.

308.4 Structural attachment. Hangers and anchors shall be attached to the building construction in an approved manner.

308.5 Interval of support. Pipe shall be supported in accordance with Table 308.5.

Exception: The interval of support for piping systems designed to provide for expansion/contraction shall conform to the engineered design in accordance with Subsection 103.6.

**TABLE 308.5
HANGER SPACING**

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
Acrylonitrile butadiene styrene (ABS) pipe	4	4
Aluminum tubing	10	15
Brass pipe	10	10
Cast-iron pipe ^a	5	15
Copper or copper-alloy pipe	12	10
Copper or copper-alloy tubing, 1 ¹ / ₄ -inch diameter and smaller	6	10
Copper or copper-alloy tubing, 1 ¹ / ₂ -inch diameter and larger	10	10
Cross-linked polyethylene (PEX) pipe	2 ² / ₃ (32 inches)	10 ^b
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	2 ² / ₃ (32 inches)	4
Chlorinated polyvinyl chloride (CPVC) pipe or tubing, 1 inch or smaller	3	10
Chlorinated polyvinyl chloride (CPVC) pipe or tubing, 1 ¹ / ₄ inches or larger	4	10
Steel pipe	12	15
Lead pipe	Continuous	4
Polybutylene (PB) pipe or tubing	2 ² / ₃ (32 inches)	4
Polyethylene/aluminum/polyethylene (PE-AL-PE) pipe	2 ² / ₃ (32 inches)	4
Polyvinyl chloride (PVC) pipe	4	10 ^b
Stainless steel drainage system	10	10 ^b

a. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.

b. Mid-story guide.

GENERAL REGULATIONS

308.6 Sway bracing. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.

308.7 Anchorage. Anchorage shall be provided to restrain drainage piping from axial movement.

308.7.1 Location. For pipe sizes greater than 4 inches, restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes. Braces, blocks, rodding and other suitable methods, as specified by the coupling manufacturer, shall be utilized.

308.8 Expansion joint fittings. Expansion joint fittings shall be used only where necessary to provide for expansion and contraction of the pipes. Expansion joint fittings shall be of the typical material suitable for use with the type of piping in which such fittings are installed.

308.9 Stacks. Bases of stacks shall be supported by concrete, brick laid in cement mortar or metal brackets attached to the building or by other approved methods.

308.10 Parallel water distribution systems. Piping bundles for manifold systems shall be supported in accordance with Table 308.5. Support at changes in direction shall be in accordance with the manufacturer's installation instructions. Hot and cold water piping shall not be grouped in the same bundle.

SECTION 309 FLOODPROOFING

309.1 General. Plumbing systems and equipment in structures erected in areas prone to flooding shall be constructed in accordance with the requirements of this Section.

309.1.1 Base flood elevation. The base flood elevation shall be used to define areas prone to flooding and shall be established in accordance with the *EPCOT Building Code*.

309.1.2 Flood hazard zones. Areas that have been determined to be prone to flooding shall be classified as either flood hazard zones (A Zones) or high-hazard zones (V Zones) in accordance with the *EPCOT Building Code*.

309.2 Flood hazard. The following systems and equipment located in a flood hazard zone (A Zone) or a high-hazard zone (V Zone) shall be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the base flood elevation.

- (a) All water service pipes.
- (b) Pump seals in individual water supply systems where the pump is located below the base flood elevation.
- (c) Covers on potable water wells shall be sealed, except where the top of the casing well or pipe sleeve is elevated to at least 1 foot above the base flood elevation.
- (d) All sanitary drainage piping.
- (e) All storm drainage piping.
- (f) Manhole covers shall be sealed, except where elevated to or above the base flood elevation.
- (g) All other plumbing piping systems and equipment.

SECTION 310 WASHROOM AND TOILET ROOM REQUIREMENTS

310.1 Light and ventilation. Washrooms and toilet rooms shall be illuminated and ventilated in accordance with the *EPCOT Building Code* and the *EPCOT Mechanical Code*.

310.2 Location of fixtures and piping. Piping, fixtures or equipment shall not be located in such a manner as to interfere with the normal operation of windows, doors or other means-of-egress openings.

310.3 Interior finish. Interior finish surfaces of toilet rooms shall comply with the *EPCOT Building Code*.

310.4 Water closet compartment. Each water closet utilized by the public or employees shall occupy a separate compartment with a door and walls or partitions between fixtures to ensure privacy.

Exceptions:

1. Water closet compartments shall not be required in a single-occupant toilet room with a lockable door.
2. Toilet rooms located in day care and child-care facilities and containing two or more water closets shall be permitted to have one water closet without an enclosing compartment.

SECTION 311 TOILET FACILITIES FOR WORKERS

311.1 General. Toilet facilities shall be provided for construction workers and such facilities shall be maintained in a sanitary condition. Construction worker toilet facilities of the nonsewer type shall conform to ANSI Z4.3.

SECTION 312 TESTS AND INSPECTIONS

312.1 Required tests. The permit holder shall perform the applicable tests prescribed in Subsections 312.2 through 312.9 to determine compliance with the provisions of this Code. The permit holder shall give reasonable advance notice to the Building Official when the plumbing work is ready for tests. The equipment, material, power and labor necessary for the inspection and test shall be furnished by the permit holder and the permit holder shall be responsible for determining that the work will withstand the test pressure prescribed in the following tests. All plumbing system piping shall be tested with either water or air. After the plumbing fixtures have been set and their traps filled with water, the entire drainage system shall be submitted to final tests. The Building Official shall require the removal of any cleanouts, if necessary, to ascertain if the pressure has reached all parts of the system.

312.1.1 Test gauges. Gauges used for testing shall be as follows:

1. Tests requiring a pressure of 10 pounds per square inch (psi) or less shall utilize a testing gauge having increments of 0.10 psi or less.
2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.

3. Tests requiring a pressure of greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.

312.2 Drainage and vent water test. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged, except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet of the system, shall have been submitted to a test of less than a 10-foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts. The system shall then be tight at all points.

312.3 Drainage and vent air test. An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi or pressure sufficient to balance a 10-inch column of mercury. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

312.4 Drainage and vent final test. The final test of the completed drainage and vent system shall be visual and in sufficient detail to determine compliance with the provisions of this Code, except that the plumbing shall be subjected to a smoke test where necessary for cause. Where the smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column shall be maintained for 15 minutes before inspection starts.

312.5 Water supply system test. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested and proved tight under a water pressure of not less than 150 psi or $1\frac{1}{2}$ times the operating pressure, whichever is greater. The water used for tests shall be obtained from a potable water source. The required tests shall be performed in accordance with this Section and Section 107.

312.6 Gravity sewer test. Gravity sewer tests shall consist of plugging the end of the building sewer at the point of connection with the public sewer, filling the building sewer with water, testing with not less than a 10-foot head of water and maintaining such pressure for 15 minutes.

312.7 Forced sewer test. Forced sewer tests shall consist of plugging the end of the building sewer at the point of connection with the public sewer and applying a pressure of 5 psi greater than the pump rating, and maintaining such pressure for 15 minutes.

312.8 Storm Drainage system test. Storm drain systems within a building shall be tested by water or air in accordance with Subsection 312.2 or 312.3.

312.9 Shower liner test. Where shower floors and receptors are made water tight by the application of materials required by Subsection 417.5.2, the completed liner installation shall be tested. The pipe from the shower drain shall be plugged water tight for the test. The floor and receptor area shall be filled with potable water to a depth of not less than 2 inches measured at the threshold. Where a threshold of at least 2 inches high does not exist, a temporary threshold shall be constructed to retain the test water in the lined floor or receptor area to a level not less than 2 inches deep measured at the threshold. The water shall be retained for a test period of not less than 15 minutes, and there shall not be evidence of leakage.

312.10 Inspection and testing of backflow prevention assemblies. Inspection and testing shall comply with Subsections 312.10.1 and 312.10.2.

312.10.1 Inspections. Annual inspections shall be made of all backflow prevention assemblies and air gaps to determine whether they are operable.

312.10.2 Testing. Reduced pressure principle backflow preventer assemblies, double check-valve assemblies, double detector check-valve assemblies and pressure vacuum breaker assemblies shall be tested at the time of installation, immediately after repairs or relocation, and at least annually. The testing procedure shall be performed in accordance with one of the following standards:

- ASSE 5010-1013-1, Sections 1 and 2
- ASSE 5010-1015-1, Sections 1 and 2
- ASSE 5010-1015-2
- ASSE 5010-1015-3, Sections 1 and 2
- ASSE 5010-1015-4, Sections 1 and 2
- ASSE 5010-1020-1, Sections 1 and 2
- ASSE 5010-1047-1, Sections 1, 2, 3 and 4
- ASSE 5010-1048-1, Sections 1, 2, 3 and 4
- ASSE 5010-1048-2
- ASSE 5010-1048-3, Sections 1, 2, 3 and 4
- ASSE 5010-1048-4, Sections 1, 2, 3 and 4
- CSA B64.10

SECTION 313 EQUIPMENT EFFICIENCIES

313.1 General. Equipment efficiencies shall be in accordance with the *EPCOT Energy Efficiency Code for Building Construction*.

SECTION 314 CONDENSATE DISPOSAL

314.1 Fuel-burning appliances. Liquid combustion byproducts of condensing appliances shall be collected and discharged to an approved plumbing fixture or disposal area in accordance with the manufacturer's installation instructions and this Code. Condensate piping shall be of approved corro-

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sion-resistant material and shall not be smaller than the drain connection on the appliance. Such piping shall maintain a minimum horizontal slope on the direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope).

314.2 Evaporators and cooling coils. Condensate drain systems shall be provided for equipment containing evaporators or cooling coils. Condensate drain systems shall be designed, constructed and installed in accordance with Sections 308, 702, 705; Subsections 314.3 through 314.6; and Table 704.1.

314.3 Condensate disposal place. Condensate from all cooling coils or evaporators shall be piped from the drip pan outlet indirectly to the sanitary sewer.

314.4 Drain pipe materials and sizes. Components of the condensate disposal system shall be galvanized steel, copper pipe or tubing, or straight (not coiled) pipe or tubing of polybutylene, polyethylene, ABS or PVC. All components shall be selected for the pressure and temperature rating of the installation. Drain piping, except for the trap, shall be straight (not coiled) tubing or pipe. Condensate waste and drain lines shall be not less than a $\frac{3}{4}$ -inch pipe size or a $\frac{7}{8}$ -inch tubing size, and shall be carried full size from the drain pan connection to the condensate disposal place. When the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with accepted engineering practice.

314.5 Dry Well or landscaping. If a sanitary connection is not located within 50 feet of a condensate source, the condensate may be piped to a dry well or landscaping. Nonsanitary disposal of condensate shall be approved by the Department of Planning and Engineering prior to construction.

314.6 Auxiliary drain pans. Auxiliary drain pans shall be installed under all coils containing a liquid or gas on which condensation will occur, or units containing coils located in attic spaces, suspended ceiling spaces, furred spaces or any area where damage could occur to the building, building contents or building occupants due to an overflow of the equipment drain pan or a stoppage in the condensate drain piping. Auxiliary pans shall have a minimum depth of $1\frac{1}{2}$ inches and shall be not less than 3 inches larger than the unit or coil dimensions in width and length, and shall be constructed of not less than 0.0276-inch galvanized sheet steel. A separate drain line shall extend from this pan terminating at a conspicuous point to serve as an alarm that the regular drain is restricted. A water level detector or float switch to control overflow may be used in auxiliary drain pans in lieu of a drain line, when approved by the Chief Mechanical Inspector.

shall be sealed in an approved manner with caulking material, foam sealant or closed with a gasketing system. The caulking material, foam sealant or gasketing system shall be designed for the conditions at the penetration location and shall be compatible with the pipe, sleeve and building materials in contact with the sealing materials. Annular spaces created by pipes penetrating fire-resistance-rated assemblies or membranes of such assemblies shall be sealed or closed in accordance with the *EPCOT Building Code*.

SECTION 315 PENETRATIONS

315.1 Sealing of annular spaces. The annular space between the outside of a pipe and the inside of a pipe sleeve or between the outside of a pipe and an opening in a building envelope wall, floor, or ceiling assembly penetrated by a pipe

CHAPTER 4

FIXTURES, FAUCETS AND FIXTURE FITTINGS

SECTION 401 GENERAL

401.1 Scope. This Chapter shall govern the materials, design and installation of plumbing fixtures, faucets and fixture fittings in accordance with the type of occupancy, and shall provide for the minimum number of fixtures for various types of occupancies.

401.2 Prohibited fixtures and connections. Pan, valve, plunger, offset, washout, latrine, frostproof and other water closets having a concealed trap seal or an unventilated space, or having walls that are not thoroughly washed at each discharge, in accordance with ASME A112.19.2, shall be prohibited. Any water closet that permits siphonage of the contents of the bowl back into the tank shall be prohibited. Trough urinals shall be prohibited.

401.3 Water conservation. The maximum water flow rates and flush volume for plumbing fixtures and fixture fittings shall comply with Subsection 604.4.

401.3.1 Lavatories. Lavatories for public use shall be equipped with a sensor-activated faucet or other approved automatic device.

401.3.2 Urinals. Urinals for public use shall be equipped with a sensor-activated flushing device or other approved automatic device.

401.3.3 Water closets. Water closets for public use shall be equipped with a sensor-activated flushing device or other approved automatic device.

SECTION 402 FIXTURE MATERIALS

402.1 Quality of fixtures. Plumbing fixtures shall be constructed of approved materials, with smooth, impervious surfaces, free from defects and concealed fouling surfaces, and shall conform to standards cited in this Code. All porcelain enameled surfaces on plumbing fixtures shall be acid resistant.

402.2 Materials for specialty fixtures. Materials for specialty fixtures not otherwise covered in this Code shall be of stainless steel, soapstone, chemical stoneware or plastic, or shall be lined with lead, copper-base-alloy, nickel-copper-alloy, corrosion-resistant steel or other material especially suited to the application for which the fixture is intended.

402.3 Sheet copper. Sheet copper for general applications shall conform to ASTM B152 and shall not weigh less than 12 ounces per square foot.

402.4 Sheet lead. Sheet lead for pans shall not weigh less than 4 pounds per square foot (psf) coated with an asphalt paint or other approved coating.

SECTION 403 MINIMUM PLUMBING FACILITIES

403.1 Minimum number of fixtures. Plumbing fixtures shall be provided for the type of occupancy and in the minimum number shown in Table 403.1. Types of occupancies not shown in Table 403.1 shall be considered individually by the Building Official. The number of occupants shall be determined by the *EPCOT Building Code*. Occupancy classification shall be determined in accordance with the *EPCOT Building Code*.

403.1.1 Unisex Toilet and bathing rooms. In assembly and mercantile occupancies, an accessible unisex toilet room shall be provided where an aggregate of six or more male and female water closets is required. In buildings of mixed occupancy, only those water closets required for the assembly or mercantile occupancy shall be used to determine the unisex toilet room requirement. In recreational facilities where separate-sex bathing rooms are provided, an accessible unisex bathing room shall be provided. Fixtures located within unisex toilet and bathing rooms shall be included in determining the number of fixtures provided in an occupancy.

Exception: Where each separate-sex bathing room has only one shower or bathtub fixture, a unisex bathing room is not required.

403.1.2 Required fixtures. Unisex toilet and bathing rooms shall comply with Subsections 403.1.3 through 403.1.4.

403.1.3 Unisex toilet rooms. Unisex toilet rooms shall include only one water closet and only one lavatory. A unisex bathing room in accordance with Subsection 403.1.4 shall be considered a unisex toilet room.

Exception: A urinal is permitted to be provided in addition to the water closet in a unisex toilet room.

403.1.4 Unisex bathing rooms. Unisex bathing rooms shall include only one shower or bathtub fixture. Unisex bathing rooms shall also include one water closet and one lavatory. Where storage facilities are provided for separate-sex bathing rooms, accessible storage facilities shall be provided for unisex bathing rooms.

403.1.5 Location. Unisex toilet and bathing rooms shall be located on an accessible route. Unisex toilet rooms shall be located not more than one story above or below separate-sex toilet rooms.

403.1.6 Clear floor space. Where doors swing into a unisex toilet or bathing room, a clear floor space not less than 30 inches by 48 inches shall be provided, within the room, beyond the area of the door swing.

403.1.7 Privacy. Doors to unisex toilet and bathing rooms shall be securable from within the room.

TABLE 403.1
MINIMUM NUMBER OF PLUMBING FIXTURES^a
(see Subsections 403.2 and 403.3)

	OCCUPANCY	WATER CLOSETS (Urinals see Subsection 419.2)		LAVATORIES	BATHTUBS/ SHOWERS	DRINKING FOUNTAINS (see Subsection 410.1)	OTHERS
		Male	Female				
ASSEMBLY	Area Development occupant load is 40% of the total occupant load of all buildings within 500 feet ^b	1 per 120	1 per 60	1 per 150	—	1 per 1,000	1 service sink
	Nightclubs ^h	1 per 40	1 per 25	1 per 75	—	1 per 500	1 service sink
	Restaurants	1 per 75	1 per 50	1 per 200	—	1 per 500	1 service sink
	Theaters, halls, museums, etc.	1 per 125	1 per 65	1 per 200	—	1 per 1,000	1 service sink
	Coliseums, arenas (less than 3,000 seats)	1 per 75	1 per 40	1 per 150	—	1 per 1,000	1 service sink
	Coliseums, arenas (3,000 seats or greater)	1 per 120	1 per 60	1 per 150	—	1 per 1,000	1 service sink
	Churches ^c	1 per 150	1 per 75	1 per 200	—	1 per 1,000	1 service sink
	Stadiums (less than 3,000 seats), pools, etc.	1 per 100	1 per 50	1 per 150	—	1 per 1,000	1 service sink
	Stadiums (3,000 seats or greater)	1 per 150	1 per 75	1 per 150	—	1 per 1,000	1 service sink
	Business (see Subsections 403.2, 403.4 and 403.5)	1 per 50		1 per 80	—	1 per 100	1 service sink
	Educational	1 per 50		1 per 50	—	1 per 100	1 service sink
	Factory and industrial	1 per 100		1 per 100	(see Section 411)	1 per 400	1 service sink
INSTITUTIONAL	Passenger terminals and transportation facilities	1 per 500		1 per 750	—	1 per 1,000	1 service sink
	Residential care	1 per 10		1 per 10	1 per 8	1 per 100	1 service sink
	Hospitals, ambulatory nursing home patients ^d	1 per room ^e		1 per room ^e	1 per 15	1 per 100	1 service sink floor
	Day nurseries ^f , sanitariums, nonambulatory nursing home patients, etc. ^d	1 per 15		1 per 15	1 per 15 ^d	1 per 100	1 service sink
	Employees, other than residential care ^d	1 per 25		1 per 35	—	1 per 100	—
	Visitors, other than residential care	1 per 75		1 per 100	—	1 per 500	—
	Prisons ^d	1 per cell		1 per cell	1 per 15	1 per 100	1 service sink
	Asylums, reformatories, etc. ^d	1 per 15		1 per 15	1 per 15	1 per 100	1 service sink
	Mercantile (see Subsections 403.2, 403.4 and 403.5)	1 per 500		1 per 750	—	1 per 1,000	1 service sink
RESIDENTIAL	Hotels, motels	1 per guest room		1 per guest room	1 per guest room	—	1 service sink
	Lodges	1 per 10		1 per 10	1 per 8	1 per 100	1 service sink
	Multiple family	1 per dwelling unit		1 per dwelling unit	1 per dwelling unit	—	1 kitchen sink per dwelling unit; 1 automatic clothes washer connection per 20 dwelling units ^g
	Dormitories	1 per 10		1 per 10	1 per 8	1 per 100	1 service sink
	One- and two-family dwellings	1 per dwelling unit		1 per dwelling unit	1 per dwelling unit	—	1 kitchen sink per dwelling unit; 1 automatic clothes washer connection per dwelling units ^g
	Storage (see Subsections 403.2 and 403.4)	1 per 100		1 per 100	(see Section 411)	1 per 1,000	1 service sink

- a. The fixtures shown are based on one fixture being the minimum required for the number of persons indicated or any fraction of the number of persons indicated. The number of occupants shall be determined by the *EPCOT Building Code*.
- b. Unless the independent evaluation (IE) study is accepted by the Building Official.
- c. Fixtures located in adjacent buildings under the ownership or control of the church shall be made available during periods when the church is occupied.
- d. Toilet facilities for employees shall be separate from facilities for inmates or patients.
- e. A single-occupant toilet room with one water closet and one lavatory serving not more than two adjacent patient rooms shall be permitted where such room is provided with direct access from each patient room and with provisions for privacy.
- f. For day nurseries, a maximum of one bathtub shall be required.
- g. For attached one- and two-family dwellings, one automatic clothes washer connection shall be required per 20 dwelling units.
- h. See Definition in Chapter 2.

403.2 Separate facilities. Where plumbing fixtures are required, separate facilities shall be provided for each sex.

Exceptions:

1. Separate facilities shall not be required in residences, apartments and nonpublic toilet rooms in hotels and motels, and similar installations in buildings, where the plumbing fixtures are intended for utilization by a family or an individual.
2. Separate employee facilities shall not be required in occupancies in which 15 or less people are employed.
3. Separate facilities shall not be required in structures or tenant spaces with a total occupant load, including both employees and customers, of 15 or less.

403.3 Number of occupants of each sex. The required water closets, lavatories, and showers or bathtubs shall be distributed equally between the sexes based on the percentage of each sex anticipated in the occupant load. The occupant load shall be composed of 50 percent of each sex, unless statistical data approved by the Building Official indicates a different distribution of the sexes.

403.4 Location of employee toilet facilities in occupancies other than assembly or business. Access to toilet facilities in occupancies other than business and assembly shall be from within the employees' regular working area. The required toilet facilities shall be located not more than one story above or below the employees' regular working area, and the path of travel to such facilities shall not exceed a distance of 500 feet. Employee facilities shall be either separate facilities or combined employee and public customer facilities.

Exception: Facilities that are required for employees in storage structures or kiosks, and are located in adjacent structures under the same ownership, lease or control, shall be a maximum travel distance of 500 feet from the employees' regular working area.

403.4.1 Travel distance. The required toilet facilities in occupancies other than assembly or mercantile shall be located not more than one story above or below the employees' regular working area and the path of travel to such facilities shall not exceed 500 feet.

Exception: The location and maximum travel distances to required employee toilet facilities in factory and industrial occupancies are permitted to exceed that required in this Subsection, provided the location and maximum travel distance are approved by the Building Official.

403.5 Location of employee toilet facilities in business and assembly occupancies. Employees shall be provided with toilet facilities in buildings and tenant spaces utilized as restaurants, nightclubs, places of public assembly and business occupancies. The employee facilities shall be either separate facilities or combined employee and public customer facilities. The required toilet facilities shall be located not more than one story above or below the employees' regular work area and the path of travel to such facilities, in other than covered malls, shall not exceed a distance of 300 feet. The path of travel to required facilities in covered malls shall not exceed a distance of 300 feet.

Exception: Employee toilet facilities shall not be required in tenant spaces where the travel distance from the main entrance of the tenant space to a central toilet area does not exceed 300 feet, and such central toilet facilities are located not more than one story above or below the tenant space.

403.6 Public facilities. Customers, patrons and visitors shall be provided with public toilet facilities in structures and tenant spaces intended for public utilization. Public toilet facilities shall be located not more than one story above or below the space required to be provided with customer public toilet facilities and the path of travel to such facilities shall not exceed a distance of 500 feet.

403.6.1 Covered malls. In covered mall buildings, required facilities shall be based on total square footage, and facilities shall be installed in each individual store or in a central toilet area located in accordance with this Subsection. The maximum travel distance to the central toilet facilities in covered mall buildings shall be measured from the main entrance of any store or tenant space.

403.6.2 Pay facilities. Required facilities shall be free of charge and designated by legible signs for each sex. Where pay facilities are installed, such facilities shall be in excess of the required minimum facilities.

403.7 Theme parks. Public restrooms in theme parks shall be computed on the theme parks maximum capacity of guests. All public area restrooms and public restrooms located inside buildings and structures shall be included for the public restroom requirements for theme parks. All area theme park public restrooms shall include all buildings, structures and attraction guest capacities within 500 feet. In no case shall public restroom capacities for theme parks be less than the maximum guest capacity of each theme park.

SECTION 404 ACCESSIBLE PLUMBING FACILITIES

404.1 Where required. Accessible plumbing facilities and fixtures shall be provided in accordance with the *EPCOT Accessibility Code for Building Construction*.

SECTION 405 INSTALLATION OF FIXTURES

405.1 Water Supply protection. The supply lines and fittings for every plumbing fixture shall be installed so as to prevent backflow.

405.2 Access for cleaning. Plumbing fixtures shall be installed so as to afford easy access for cleaning both the fixture and the area around the fixture.

405.3 Setting. Fixtures shall be set level and in proper alignment with reference to adjacent walls.

405.3.1 Water closets, lavatories and bidets. A water closet, lavatory or bidet shall not be set closer than 15 inches clear from its center to any sidewall, partition, vanity or other obstruction, or closer than 30 inches center-to-center (without partitions or dividers) between toilets or adjacent fixtures. There shall be at least 21 inches clear-

ance in front of the water closet or bidet to any wall, fixture or door. Water closet compartments shall not be less than 30 inches wide and 60 inches deep. There shall be at least 21 inches clearance in front of a lavatory to any wall, fixture or door. (See Figure 405.3.1.)

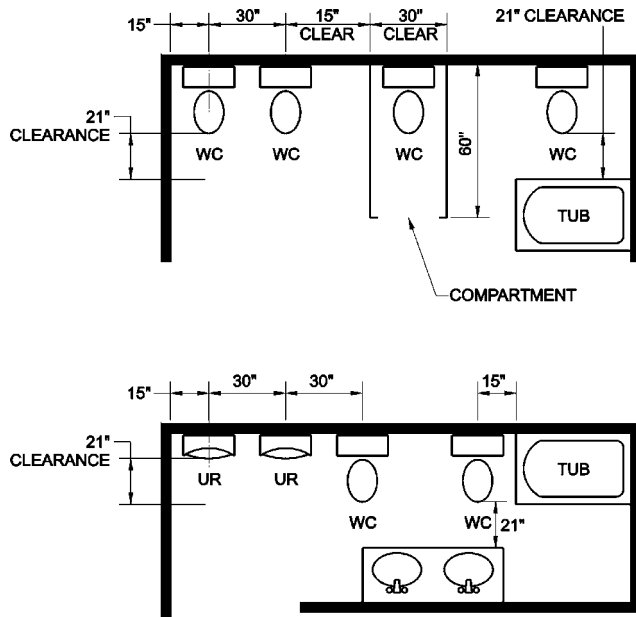


FIGURE 405.3.1
FIXTURE CLEARANCES

405.3.2 Urinals. A urinal shall not be set closer than 15 inches from the center of the urinal to any sidewall, partition, vanity or other obstruction, or closer than 30 inches center-to-center between urinals. (See Figure 405.3.1.)

405.4 Floor and wall drainage connections. Connections between the drain and floor outlet plumbing fixtures shall be made with a floor flange. The flange shall be attached to the drain and anchored to the structure. Connections between the drain and wall-hung water closets shall be made with an approved extension nipple or horn adapter. The water closet shall be bolted to the hanger with corrosion-resistant bolts or screws. Joints shall be sealed with an approved elastomeric gasket or setting compound conforming to FS TT-P-1536a.

405.4.1 Floor flanges. Floor flanges for water closets or similar fixtures shall not be less than $\frac{1}{8}$ inch thick for brass, $\frac{1}{4}$ inch thick for plastic, and $\frac{1}{4}$ inch thick and not less than a 2-inch caulking depth for cast-iron or galvanized malleable iron.

Floor flanges of hard lead shall weigh not less than 1 pound, 9 ounces and shall be composed of lead alloy with not less than 7.75 percent antimony by weight. Closet screws and bolts shall be of brass. Flanges shall be secured to the building structure with corrosion-resistant screws or bolts.

405.4.2 Securing floor outlet fixtures. Floor outlet fixtures shall be secured to the floor or floor flanges by screws or bolts of corrosion-resistant material.

405.4.3 Securing wall-hung water closet bowls. Wall-hung water closet bowls shall be supported by a concealed metal carrier that is attached to the building structural members so that strain is not transmitted to the closet connector or any other part of the plumbing system. The carrier shall conform to ASME A112.6.1.

405.5 Water-tight joints. Joints formed where fixtures come in contact with walls or floors shall be sealed.

405.6 Plumbing in mental health centers. In mental health centers, pipes or traps shall not be exposed, and fixtures shall be bolted through walls.

405.7 Design of Overflows. Where any fixture is provided with an overflow, the waste shall be designed and installed so that standing water in the fixture will not rise in the overflow when the stopper is closed, and no water will remain in the overflow when the fixture is empty.

405.7.1 Connection of overflows. The overflow from any fixture shall discharge into the drainage system on the inlet or fixture side of the trap.

Exception: The overflow from a flush tank serving a water closet or urinal shall discharge into the fixture served.

405.8 Access to concealed connections. Fixtures with concealed slip-joint connections shall be provided with an access panel or utility space at least 12 inches in its smallest dimension or other approved arrangement so as to provide access to the slip connections for inspection and repair. Where such access cannot be provided, access doors shall not be required, provided that all joints are soldered, solvent cemented or screwed so as to form a solid connection.

405.9 Design and installation of plumbing fixtures. Integral fixture fitting mounting surfaces on manufactured plumbing fixtures or plumbing fixtures constructed on-site, shall meet the design requirements of ASME A112.19.2/CSA B45.1 or ASME A112.19.3/CSA B45.4.

SECTION 406 AUTOMATIC CLOTHES WASHERS

406.1 Approval. Domestic automatic clothes washers shall conform to ASSE 1007.

406.2 Water connection. The water supply to an automatic clothes washer shall be protected against backflow by an air gap installed integrally within the machine conforming to ASSE 1007 or with the installation of a backflow preventer in accordance with Subsection 608.15.4.2.

406.3 Waste connection. The discharge from an automatic clothes washer shall be through an air break and connected to a standpipe in accordance with Subsection 802.4.

406.4 Lint interceptor. In laundry rooms, the installation of three or more domestic-type automatic clothes washing machines shall require an approved lint interceptor. Lint interceptor capacity shall be determined by the maximum dis-

charge of all clothes washers, and shall conform to Subsection 1003.9.

SECTION 407 BATHTUBS

407.1 Approval. Bathtubs shall conform to ANSI Z124.1, ASME A112.19.1, ASME A112.19.4, ASME A112.19.9, CSA B45.2, CSA B45.3 or CSA B45.5.

407.2 Bathtub waste outlets. Bathtubs shall have waste outlets a minimum of 1½ inches in diameter. The waste outlet shall be equipped with an approved stopper.

407.3 Glazing. Windows and doors within a bathtub enclosure shall conform to the safety glazing requirements of the *EPCOT Building Code*.

407.4 Bathtub enclosure. Doors within a bathtub enclosure shall conform to ASME A112.19.15.

SECTION 408 BIDETS

408.1 Approval. Bidets shall conform to ASME A112.19.2, ASME A112.19.9 or CSA B45.1.

408.2 Water connection. The water supply to a bidet shall be protected against backflow by an air gap or backflow preventer in accordance with Subsection 608.13.1, 608.13.2, 608.13.3, 608.13.5, 608.13.6 or 608.13.8.

408.3 Bidet water temperature. The discharge water temperature from a bidet fitting shall be limited to a maximum temperature of 110°F by a water temperature limiting device conforming to ASSE 1070 or CSA B125.3.

SECTION 409 DISHWASHING MACHINES

409.1 Approval. Domestic dishwashing machines shall conform to ASSE 1006. Commercial dishwashing machines shall conform to ASSE 1004 and ANSI/NSF 3.

409.2 Water connection. The water supply to a dishwashing machine shall be protected against backflow by an air gap or backflow preventer in accordance with Section 608.

409.3 Waste connection. The waste connection of a dishwashing machine shall comply with Subsection 409.3.1 or 409.3.2.

409.3.1 Domestic dishwashing machines. Domestic dishwashing machines shall discharge indirectly through an air gap or air break into a standpipe or waste receptor in accordance with Subsection 802.2, or discharge into a wye-branch fitting on the tailpiece of the kitchen sink or the dishwasher connection of a food waste grinder. The waste line of a domestic dishwashing machine discharging into a kitchen sink tailpiece or food grinder shall connect to a deck-mounted air gap or the waste line riser and be securely fastened to the underside of the rim or counter.

409.3.2 Commercial dishwashing machines. The discharge from a commercial dishwashing machine shall be through an air gap or air break into a standpipe or waste receptor in accordance with Subsection 802.2.

SECTION 410 DRINKING FOUNTAINS

410.1 Approval. Drinking fountains shall conform to ASME A112.19.1/CSA B45.2 or A112.19.2/CSA B45.1, and water coolers shall conform to AHRI 1010. Drinking fountains and water coolers shall conform to NSF 61 Section 9.

410.2 Minimum number. Where drinking fountains are required, not fewer than two drinking fountains shall be provided. One drinking fountain shall comply with the requirements for people who use a wheelchair and one drinking fountain shall comply with the requirements for standing persons.

Exception: A single drinking fountain that complies with the requirements for people who use a wheelchair and standing persons shall be permitted to be substituted for two separate drinking fountains.

410.3 Substitution. Where restaurants provide drinking water in a container free of charge, drinking fountains shall not be required in those restaurants. In other occupancies, where drinking fountains are required, water coolers or bottled water dispensers shall be permitted to be substituted for not more than 50 percent of the required number of drinking fountains.

410.2 Prohibited location. Drinking fountains, water coolers and bottled water dispensers shall not be installed in public restrooms.

SECTION 411 EMERGENCY SHOWERS AND EYEWASH STATIONS

411.1 Water connection. Emergency showers and eyewash stations shall be provided with a supply of cold water that is required to supply 30 gallons per minute at the shower head with the eyewash in the full-open position.

411.2 Waste connection. Waste connections shall not be required for emergency showers and eyewash stations.

411.3 Installation. When required, emergency showers and eyewash stations shall be installed in accordance with ANSI 4-5. Emergency showers and eyewash stations shall have a quick-opening/closing 1¼-inch ball valve in the water supply and readily accessible within 6 feet of the station. Emergency showers and eyewash stations exposed to weather shall be protected from freezing.

SECTION 412 FLOOR AND TRENCH DRAINS

412.1 Approval. Floor drains shall conform to ASME A112.3.1, ASME A112.21.1 or CSA B79. Trench drains shall comply with ASME A112.6.3.

412.2 Floor drains and strainer. Floor drains shall have removable strainers. The floor drain shall be constructed so that the drain is capable of being cleaned. Access shall be provided to the drain inlet. Ready access shall be provided to floor drains.

Exception: Floor drains serving refrigerated display cases shall be provided with access.

412.3 Size of floor drains. Floor drains shall have a minimum 2-inch-diameter drain outlet.

412.4 Public laundries and central washing facilities. In public coin-operated laundries and the central washing facilities of multiple-family dwellings, the rooms containing the automatic clothes washers shall be provided with floor drains located to readily drain the entire floor area. Such drains shall have a minimum outlet cross section of not less than 3 inches in diameter.

412.5 Public toilet rooms and mechanical equipment rooms. Floor drains shall be installed in all public toilet rooms, mechanical equipment rooms (not used as a plenum) and accessible plumbing chases. The floor drains shall be not less than 3 inches and the trap shall be equipped with a trap primer connected to the fixture waste outlet in order to maintain the water seal in the floor drain trap. If no waste outlet is available, the trap primer may be connected to the cold water supply.

412.6 Prohibited location. No floor drain or other plumbing fixture, except electric water heaters, shall be installed in a room containing air-handling equipment when such room is used as a plenum. When rooms are used as a plenum, equipment drains shall be conveyed through an indirect waste receptor located outside such rooms or other approved points of disposal.

412.6.1 Elevator pits. Floor drains directly connected to the plumbing system shall not be located in elevator pits.

SECTION 413 FOOD WASTE GRINDER UNITS

413.1 Approval. Domestic food waste grinders shall conform to ASSE 1008. Commercial food waste grinders shall conform to ASSE 1009. Food waste grinders shall not increase the drainage fixture unit load on the sanitary drainage system.

413.2 Domestic food waste grinder waste outlets. Domestic food waste grinders shall be connected to a drain of not less than 1½ inches in diameter.

413.3 Commercial food waste grinder waste outlets. Commercial food waste grinders shall be connected to a drain a minimum of 2 inches in diameter. Commercial food waste grinders shall be connected and trapped separately from any other fixtures or sink compartments.

413.4 Water supply required. All food waste grinders shall be provided with a supply of cold water. The water supply shall be protected against backflow by an air gap or backflow preventer in accordance with Section 608.

SECTION 414 GARBAGE CAN WASHERS

414.1 Water connection. The water supply to a garbage can washer shall be protected against backflow by an air gap or a backflow preventer in accordance with Subsection 608.13.1, 608.13.2, 608.13.3, 608.13.5, 608.13.6 or 608.13.8.

414.2 Waste connection. Garbage can washers shall be trapped separately. The receptacle receiving the waste from

the washer shall have a removable basket or strainer to prevent the discharge of large particles into the drainage system.

SECTION 415 LAUNDRY TRAYS

415.1 Approval. Laundry trays shall conform to ANSI Z124.6, ASME A112.19.1, ASME A112.19.3, ASME A112.19.9, CSA B45.2 or CSA B45.4.

415.2 Waste outlet. Each compartment of a laundry tray shall be provided with a waste outlet a minimum of 1½ inches in diameter and a strainer or crossbar to restrict the clear opening of the waste outlet.

SECTION 416 LAVATORIES

416.1 Approval. Lavatories shall conform to ANSI Z124.3, ASME A112.19.1, ASME A112.19.2, ASME A112.19.3, ASME A112.19.4, ASME A112.19.9, CSA B45.1, CSA B45.2, CSA B45.3 or CSA B45.4. Group wash-up equipment shall conform to the requirements of Section 402. Every 20 inches of rim space shall be considered one lavatory.

416.2 Cultured marble lavatories. Cultured marble vanity tops with an integral lavatory shall conform to ANSI Z124.3 or CSA B45.5.

416.3 Lavatory waste outlets. Lavatories shall have waste outlets not less than 1¼ inches in diameter. A strainer, pop-up stopper, crossbar or other device shall be provided to restrict the clear opening of the waste outlet.

SECTION 417 SHOWERS

417.1 Approval. Prefabricated showers and shower compartments shall conform to ANSI Z124.2, ASME A112.19.9 or CSA B45.5. Shower valves for individual showers shall conform to the requirements of Subsection 424.4.

417.2 Water supply riser. Every water supply riser from the shower valve to the shower head outlet, whether exposed or not, shall be attached to the structure in an approved manner.

417.3 Shower waste outlet. Waste outlets serving showers shall be at least 2 inches in diameter and, for other than waste outlets in bathtubs, shall have removable strainers not less than 3 inches in diameter with strainer openings not less than ¼ inch in minimum dimension. Where each shower space is not provided with an individual waste outlet, the waste outlet shall be located and the floor pitched so that waste from one shower does not flow over the floor area serving another shower. Waste outlets shall be fastened to the waste pipe in an approved manner.

417.4 Shower compartments. All shower compartments shall have a minimum of 900 square inches of interior cross-sectional area. Shower compartments shall not be less than 30 inches in minimum dimension measured from the finished interior dimension of the compartment, exclusive of fixture valves, shower heads, soap dishes, and safety grab bars or rails. The 30-inch minimum dimension shall be measured as

the side of a rectangle, altitude of a triangle or diameter of a circle. Except as required in the *EPCOT Accessibility Code for Building Construction*, the minimum required area and dimension shall be measured from the finished interior dimension at a height equal to the top of the threshold and at a point tangent to its centerline.

417.4.1 Wall area. The wall area above built-in tubs with installed shower heads and in shower compartments shall be constructed of smooth, noncorrosive and nonabsorbent waterproof materials to a height not less than 6 feet above the room floor level, and not less than 70 inches where measured from the compartment floor at the drain. Such walls shall form a water-tight joint with each other, and with either the tub, receptor or shower floor.

417.5 Shower floors or receptors. Floor surfaces shall be constructed of impervious, noncorrosive, nonabsorbent and waterproof materials.

417.5.1 Support. Floors or receptors under shower compartments shall be laid on, and supported by, a smooth and structurally sound base.

417.5.2 Shower lining. Floors under shower compartments, except where prefabricated receptors have been provided, shall be lined and made water tight utilizing material complying with Subsections 417.5.3 through 417.5.8. Such liners shall turn up on all sides at least 2 inches above the finished threshold level. Liners shall be recessed and fastened to an approved backing so as not to occupy the space required for wall covering, and shall not be nailed or perforated at any point less than 1 inch above the finished threshold. Liners shall be pitched one-fourth unit vertical in 12 units horizontal (2-percent slope), sloped toward the fixture drains and securely fastened to the waste outlet at the seepage entrance, making a water-tight joint between the liner and the outlet. The completed liner shall be tested in accordance with Subsection 312.9.

Exceptions:

1. Floor surfaces under shower heads provided for rinsing, laid directly on the ground, are not required to comply with this Subsection.
2. Where a sheet-applied, load-bearing, bonded, waterproof membrane is installed as the shower lining, the membrane shall not be required to be recessed.

417.5.3 PVC sheets. Plasticized polyvinyl chloride (PVC) sheets shall be a minimum of 0.040 inch thick, and shall meet the requirements of ASTM D4551. Sheets shall be joined by solvent welding in accordance with the manufacturer's installation instructions.

417.5.4 CPE sheets. Nonplasticized chlorinated polyethylene (CPE) sheets shall be a minimum 0.040 inch thick and shall meet the requirements of ASTM D4068. The liner shall be joined in accordance with the manufacturer's installation instructions.

417.5.5 Sheet lead. Sheet lead shall not weigh less than 4 pounds per square foot and shall be coated with an asphalt

paint or other approved coating. The lead sheet shall be insulated from conducting substances other than the connecting drain by 15-pound asphalt felt or its equivalent. Sheet lead shall be joined by burning.

417.5.6 Sheet copper. Sheet copper shall conform to ASTM B152 and shall not weigh less than 12 ounces per square foot. The copper sheet shall be insulated from conducting substances other than the connecting drain by 15-pound asphalt felt or its equivalent. Sheet copper shall be joined by brazing or soldering.

417.5.7 Sheet-applied, load-bearing, bonded, waterproof membranes. Sheet-applied, load-bearing, bonded, waterproof membranes shall meet requirements of ANSI A118.10 and shall be applied in accordance with the manufacturer's installation instructions.

417.5.8 Liquid-type, trowel-applied, load-bearing, bonded waterproof materials. Liquid-type, trowel applied, load-bearing, bonded waterproof materials shall meet the requirements of ANSI A118.10 and shall be applied in accordance with the manufacturer's instructions.

417.6 Glazing. Windows and doors within a shower enclosure shall conform to the safety glazing requirements of the *EPCOT Building Code*.

SECTION 418 SINKS

418.1 Approval. Sinks shall conform to ANSI Z124.6, ASME A112.19.1, ASME A112.19.2, ASME A112.19.3, ASME A112.19.4, ASME A112.19.9, CSA B45.1, CSA B45.2, CSA B45.3 or CSA B45.4.

418.2 Sink waste outlets. Sinks shall be provided with waste outlets a minimum of 1½ inches in diameter. A strainer or crossbar shall be provided to restrict the clear opening of the waste outlet. Sinks on which a food waste grinder is installed shall have a waste opening a minimum of 3½ inches in diameter.

418.3 Moveable sink systems. Moveable sink systems shall comply with ASME A112.19.12.

SECTION 419 URINALS

419.1 Approval. Urinals shall conform to ASME A112.19.2, CSA B45.1 or CSA B45.5. Urinals shall conform to the water consumption requirements of Subsection 604.4. Urinals shall conform to the hydraulic performance requirements of ASME A112.19.6, CSA B45.1 or CSA B45.5.

419.2 Substitution for water closets. In each bathroom or toilet room, urinals shall not be substituted for more than 50 percent of the required water closets.

419.3 Surrounding material. Wall and floor space to a point 2 feet in front of a urinal lip and 4 feet above the floor, and at least 2 feet to each side of the urinal, shall be waterproofed with a smooth, readily cleanable, nonabsorbent material.

SECTION 420 WATER CLOSETS

420.1 Approval. Water closets shall conform to the water consumption requirements of Subsection 604.4, and shall conform to ANSI Z124.4, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5. Water closets shall conform to the hydraulic performance requirements of ASME A112.19.2/CSA B45.1. Water closet tanks shall conform to ANSI Z124.4, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5. Electro-hydraulic water closets shall comply with ASME A112.19.2/CSA B45.1.

420.2 Water closets for public or employee toilet facilities. Water closet bowls for public or employee toilet facilities shall be of the elongated type.

420.3 Water closet seats. Water closets shall be equipped with seats of smooth, nonabsorbent material. All seats of water closets provided for public or employee toilet facilities shall be of the hinged, open-front type. Integral water closet seats shall be of the same material as the fixture. Water closet seats shall be sized for the water-closet-bowl type.

420.4 Water closet connections. A 4-inch by 3-inch closet bend shall be acceptable. Where a 3-inch bend is utilized on water closets, a 4-inch by 3-inch flange shall be installed to receive the fixture horn.

SECTION 421 WHIRLPOOL BATHTUBS

421.1 Approval. Whirlpool bathtubs shall comply with ASME A112.19.7/CSA B45.10.

421.2 Installation. Whirlpool bathtubs shall be installed and tested in accordance with the manufacturer's installation instructions. The pump shall be located above the weir of the fixture trap.

421.3 Drain. The pump drain and circulation piping shall be sloped to drain the water in the volute and the circulation piping when the whirlpool bathtub is empty.

421.4 Suction fittings. Suction fittings for whirlpool bathtubs shall comply with ASME A112.19.7/CSA B45.10.

421.5 Access to pump. Access shall be provided to circulation pumps in accordance with the fixture or pump manufacturer's installation instructions. Where the manufacturer's instructions do not specify the location and minimum size of field-fabricated access openings, an opening not less than 12-inches by 12-inches shall be installed to provide access to the circulation pump. Where pumps are located more than 2 feet from the access opening, an opening not less than 18-inches by 18-inches shall be installed. A door or panel shall be permitted to close the opening. In all cases, the access opening shall be unobstructed and of the size necessary to permit the removal and replacement of the circulation pump.

421.6 Whirlpool enclosure. Doors within a whirlpool enclosure shall conform to ASME A112.19.15.

SECTION 422 HEALTH CARE FIXTURES AND EQUIPMENT

422.1 Scope. This Section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to the requirements of this Section, in addition to the other requirements of this Code. The provisions of this Section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes, homes for the aged, orphanages, infirmaries, first aid stations, psychiatric facilities, clinics, professional offices of dentists and doctors, mortuaries, educational facilities, surgery, dentistry, research and testing laboratories, establishments manufacturing pharmaceutical drugs and medicines, and other structures with similar apparatus and equipment classified as plumbing.

422.2 Approval. All special plumbing fixtures, equipment, devices and apparatus shall be of an approved type and shall conform to the requirements in Appendix H, as well as other Sections of this Code.

SECTION 423 SPECIALTY PLUMBING FIXTURES

423.1 Water connections. Baptisteries, ornamental and lily pools, aquariums, ornamental fountain basins, swimming pools and similar constructions, where provided with water supplies, shall be protected against backflow in accordance with Section 608.

423.2 Approval. Specialties requiring water and waste connections shall be submitted for approval.

SECTION 424 FAUCETS AND OTHER FIXTURE FITTINGS

424.1 Approval. Faucets and fixture fittings shall conform to ASME A112.18.1 or CSA B125. Faucets and fixture fittings that supply drinking water for human ingestion shall conform to the requirements of Section 9 of ANSI/NSF 61.

424.1.1 Faucets and supply fittings. Faucets and supply fittings shall conform to the water consumption requirements of Subsection 604.4.

424.1.2 Waste fittings. Waste fittings shall conform to one of the standards listed in Tables 702.1 and 702.4 for above-ground drainage, and vent pipe and fittings, or the waste fittings shall be constructed of tubular stainless steel with a minimum wall thickness of 0.012 inch, tubular copper alloy having a minimum wall thickness of 0.027 inch or tubular plastic complying with ASTM F409.

424.2 Hose spray. Diverters for sink faucets with a secondary outlet consisting of a flexible hose and spray assembly shall conform to ASSE 1025, in addition to the requirements in Subsection 424.1.

424.3 Hand showers. Hand-held showers shall conform to ASSE 1014 or CSA CAN/CSA-B125.

424.4 Shower valves. Shower and tub-shower combination valves shall be balanced pressure, thermostatic or combination balanced pressure/thermostatic valves that conform to the requirements of ASSE 1016 or CSA CAN/CSA-B125. Valves shall be equipped with a means to limit the maximum setting of the valve to 120°F, which shall be field adjusted in accordance with the manufacturer's installation instructions. Multiple (gang) showers supplied with a single tempered water supply pipe shall have the water supply for such showers controlled by an approved master thermostatic mixing valve.

424.5 Multiple (gang) showers. Multiple (gang) showers supplied with a single-tempered water supply pipe shall have the water supply for such showers controlled by an approved automatic temperature control mixing valve that conforms to ASSE 1069 or CSA B125.3, or each shower head shall be individually controlled by a balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valve that conforms to ASSE 1016 or ASME A112.18.1/CSA B125.1 and is installed at the point of use. Such valves shall be equipped with a means to limit the maximum setting of the valve to 120°F, which shall be field adjusted in accordance with the manufacturers' instructions.

424.6 Bathtub and whirlpool bathtub valves. The hot water supplied to bathtubs and whirlpool bathtubs shall be limited to a maximum temperature of 120°F by a water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3, except where such protection is otherwise provided by a combination tub/shower valve in accordance with Subsection 424.4.

424.7 Hose-connected outlets. Faucets and fixture fittings with hose-connected outlets shall conform to ASME A112.18.3 or ASME A112.18.1/CSA B125.1.

SECTION 425 FLUSHING DEVICES FOR WATER CLOSETS AND URINALS

425.1 Flushing devices required. Each water closet, urinal, clinical sink and any plumbing fixture that depends on trap siphonage to discharge the fixture contents to the drainage system shall be provided with a flushometer valve, flushometer tank or flush tank designed and installed to supply water in a quantity and rate of flow to flush the contents of the fixture, cleanse the fixture and refill the fixture trap.

425.1.1 Separate for each fixture. A flushing device shall not serve more than one fixture.

425.2 Access to concealed connections. Fixtures with concealed slip-joint connections shall be provided with an access panel or utility space at least 12 inches in its smallest dimension or other approved arrangement so as to provide access to the slip connections for inspection and repair. (See Subsection 705.15.)

425.3 Flushometer valves and tanks. Flushometer valves and tanks shall comply with ASSE 1037. Vacuum breakers on flushometer valves shall conform to the performance requirements of ASSE 1001 or CSA CAN/CSA-B64.1.1. Access shall be provided to vacuum breakers. Flushometer valves

shall be of the water-conservation type and shall not be utilized where the water pressure is lower than the minimum required for normal operation. When operated, the valve shall automatically complete the cycle of operation, opening fully and closing positively under the water supply pressure. Each flushometer valve shall be provided with a means for regulating the flow through the valve. The trap seal to the fixture shall be automatically refilled after each valve flushing cycle.

425.4 Flush tanks. Flush tanks equipped for manual flushing shall be controlled by a device designed to refill the tank after each discharge and to shut off completely the water flow to the tank when the tank is filled to operational capacity. The trap seal to the fixture shall be automatically refilled after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled with a timing device or sensor-control devices.

425.4.1 Ball cocks. All flush tanks shall be equipped with an anti-siphon ball cock conforming to ASSE 1002 or CSA CAN/CSA-B125. The ball cock backflow preventer shall be located at least 1 inch above the full opening of the overflow pipe.

425.4.2 Overflows in flush tanks. Flush tanks shall be provided with overflows discharging to the water closet or urinal connected thereto and shall be sized to prevent flooding the tank at the maximum rate at which the tanks are supplied with water. The opening of the overflow pipe shall be located above the flood level rim of the water closet or urinal, or above a secondary overflow in the flush tank.

425.4.3 Sheet copper. Sheet copper utilized for flush tank linings shall conform to ASTM B152 and shall not weigh less than 10 ounces per square foot.

425.4.4 Access required. All parts in a flush tank shall be accessible for repair and replacement.

SECTION 426 MANUAL FOOD AND BEVERAGE DISPENSING EQUIPMENT

426.1 Approval. Manual food and beverage dispensing equipment shall conform to the requirements of ANSI/NSF 18.

CHAPTER 5

WATER HEATERS

SECTION 501 GENERAL

501.1 Scope. The provisions of this Chapter shall govern the materials, design and installation of water heaters, and the related safety devices and appurtenances.

501.2 Water heater as space heater. Where a combination potable water heating and space heating system requires water for space heating at temperatures higher than 140°F, a tempering valve shall be provided to limit the water supplied to the potable hot water distribution system to a maximum temperature of 140°F. The potability of the water shall be maintained throughout the system.

501.3 Drain valves. Drain valves for emptying shall be installed at the bottom of each tank-type water heater and hot water storage tank. Drain valves shall conform to ASSE 1005.

501.4 Location. Water heaters and storage tanks shall be located and connected so as to provide access for observation, maintenance, servicing and replacement.

501.5 Water heater labeling. All water heaters shall bear the label of an approved agency.

501.6 Water temperature control in piping from tankless heaters. The temperature of water from tankless water heaters shall be a maximum of 140°F when intended for domestic uses. This provision shall not supersede the requirement for protective shower valves in accordance with Subsection 424.4.

501.7 Pressure marking of storage tanks. Storage tanks and water heaters installed for domestic hot water shall have the maximum allowable working pressure clearly and indelibly stamped in the metal or marked on a plate welded thereto, or otherwise permanently attached. Such markings shall be in an accessible position outside of the tank so as to make inspection or reinspection readily possible.

501.8 Temperature controls. All hot water supply systems shall be equipped with automatic temperature controls capable of adjustments from the lowest to the highest acceptable temperature settings for the intended temperature operating range.

SECTION 502 INSTALLATION

502.1 General. Water heaters shall be installed in accordance with the manufacturer's installation instructions. Oil-fired water heaters shall conform to the requirements of this Code and the *EPCOT Mechanical Code*. Electric water heaters shall conform to the requirements of this Code and the provisions of the *EPCOT Electrical Code*. Gas-fired water heaters shall conform to the requirements of the *EPCOT Fuel Gas Code*.

502.2 Water heaters installed in garages. Water heaters having an ignition source shall be elevated such that the source of ignition is not less than 18 inches above the garage floor.

502.3 Rooms used as a plenum. Water heaters using solid, liquid or gas fuel shall not be installed in a room containing air-handling machinery when such room is used as a plenum.

502.4 Prohibited location. Fuel-fired water heaters shall not be installed in a sleeping room, bathroom or a closet accessed through a sleeping room or bathroom.

Exception: Direct-vent water heaters.

502.5 Water heaters installed in attics. Attics containing a water heater shall be provided with an opening and unobstructed passageway large enough to allow the removal of the water heater. The passageway shall not be less than 30 inches high and 22 inches wide, and not more than 20 feet in length when measured along the centerline of the passageway from the opening to the water heater. The passageway shall have continuous solid flooring not less than 24 inches wide. A level service space at least 30 inches deep and 30 inches wide shall be present at the front or service side of the water heater. The clear access opening dimensions shall be a minimum of 20 inches by 30 inches where such dimensions are large enough to allow the removal of the water heater.

SECTION 503 CONNECTIONS

503.1 Cold water line valve. The cold water branch line from the main water supply line to each hot water storage tank or water heater shall be provided with a valve accessible on the same floor, located near the equipment and only serving the hot water storage tank or water heater. The valving shall not interfere or cause a disruption of the cold water supply to the remainder of the cold water system.

503.2 Water circulation. The method of connecting a circulating water heater to the tank shall provide the proper circulation of water through the water heater. The pipe or tubes required for the installation of appliances that will draw from the water heater or storage tank shall comply with the provisions of this Code for material and installation.

SECTION 504 SAFETY DEVICES

504.1 Anti-siphon devices. An approved means shall be provided to prevent siphoning of any storage water heater or tank. A cold water "dip" tube with a hole at the top or a vacuum relief valve installed in the cold water supply line above the top of the heater or tank shall be approved for this purpose.

WATER HEATERS

504.2 Vacuum relief valve. Bottom-fed water heaters and bottom-fed tanks connected to water heaters shall have a vacuum relief valve installed. The vacuum relief valve shall comply with ANSI Z21.22.

504.3 Shutdown. A separate switch shall be provided to terminate the energy supplied to electric hot water supply systems. A separate valve shall be provided to turn off the energy supplied to the main burner of all other types of hot water supply systems.

504.4 Relief valve. All storage water heaters operating above atmospheric pressure shall be provided with an approved, self-closing (levered) pressure relief valve and temperature relief valve, or combination thereof. The relief valve shall conform to ANSI Z21.22. The relief valve shall not be used as a means of controlling thermal expansion.

504.4.1 Installation. Such valves shall be installed in the shell of the water heater tank. Temperature relief valves shall be so located in the tank as to be actuated by the water in the top 6 inches of the tank served. For installations with separate storage tanks, the valves shall be installed on the tank and there shall not be any type of valve installed between the water heater and the storage tank. There shall not be a check valve or shutoff valve between a relief valve and the heater or tank served.

504.5 Relief valve approval. Temperature and pressure relief valves, or combinations thereof, and energy cutoff devices shall bear the label of an approved agency, and shall have a temperature setting of not more than 210°F and a pressure setting not exceeding the tank or water heater manufacturer's rated working pressure or 150 pounds per square inch, whichever is less. The relieving capacity of each pressure relief valve and each temperature relief valve shall equal or exceed the heat input to the water heater or storage tank.

504.6 Relief outlet waste. The outlet of a pressure, temperature or other relief valve shall not be directly connected to the drainage system.

504.6.1 Discharge. The relief valve shall discharge full size to a safe place of disposal, such as the floor, outside the building or an indirect waste receptor. The discharge pipe shall not have any trapped sections and shall have a visible air gap or air gap fitting located in the same room as the water heater. The discharge shall be installed in a manner that does not cause personal injury to occupants in the immediate area or structural damage to the building.

504.6.2 Materials. Relief valve discharge piping shall be of those materials listed in Subsection 605.5, or shall be tested, rated and approved for such use in accordance with ASME A112.4.1. Piping from safety pan drains shall be of those materials listed in Table 605.5.

504.7 Required pan. Where water heaters or hot water storage tanks are installed in locations where leakage of the tanks or connections will cause damage, the tank or water heater shall be installed in a galvanized steel or other metal pan of equal corrosion resistance having a minimum thickness of 24 gage, 0.0276 inch. Electric water heaters shall be installed in a metal pan as herein required or in a high-impact plastic pan of at least 0.0625-inch thickness.

504.7.1 Pan size and drain. The pan shall not be less than 1½ inches deep, and shall be of sufficient size and shape to receive all dripping or condensate from the tank or water heater. The pan shall be drained by an indirect waste pipe having a minimum diameter of 1 inch or the outlet diameter of the required relief valve, whichever is larger.

504.7.2 Pan drain termination. The pan drain shall extend full size and terminate over a suitably located indirect waste receptor or floor drain, or extend to the exterior of the building and terminate not less than 6 inches or more than 24 inches above the adjacent ground surface.

SECTION 505 INSULATION

505.1 Unfired vessel insulation. Unfired hot water storage tanks shall be insulated so that heat loss is limited to a maximum of 15 British thermal units per hour per square foot of external tank surface area. For purposes of determining this heat loss, the design ambient temperature shall not be higher than 65°F.

CHAPTER 6

WATER SUPPLY AND DISTRIBUTION

SECTION 601 GENERAL

601.1 Scope. This Chapter shall govern the materials, design and installation of water supply systems, both hot and cold, for utilization in connection with human occupancy and habitation, and shall govern the installation of individual water supply systems.

601.2 Solar energy utilization. Solar energy systems used for heating potable water or using an independent medium for heating potable water shall comply with the applicable requirements of this Code. The use of solar energy shall not compromise the requirements for cross connection or protection of the potable water supply system required by this Code.

601.3 Existing piping used for grounding. Existing metallic water service piping used for electrical grounding shall not be replaced with nonmetallic pipe or tubing until other approved means of grounding are provided.

601.4 Tests. The potable water distribution system shall be tested in accordance with Subsection 312.5.

SECTION 602 WATER REQUIRED

602.1 General. Every structure equipped with plumbing fixtures and utilized for human occupancy or habitation shall be provided with a potable supply of water in the amounts and at the pressures specified in this Chapter.

602.2 Potable water required. Only potable water shall be supplied to plumbing fixtures that provide water for drinking, bathing or culinary purposes, or for the processing of food, medical or pharmaceutical products. Unless otherwise provided in this Code, potable water shall be supplied to all plumbing fixtures.

602.3 Individual water supply. Where a potable public water supply is not available, individual sources of potable water supply shall be utilized.

602.3.1 Sources. Dependent on geological and soil conditions, and the amount of rainfall, individual water supplies are of the following types: drilled well, driven well, dug well, bored well, spring, stream or cistern. Surface bodies of water and land cisterns shall not be sources of individual water supply unless properly treated by approved means to prevent contamination.

602.3.2 Minimum quantity. The combined capacity of the source and storage in an individual water supply system shall supply the fixtures with water at rates and pressures as required by this Chapter.

602.3.3 Water quality. Water from an individual water supply shall be approved as potable by the authority having jurisdiction prior to the connection to the plumbing system.

602.3.4 Disinfection of system. After construction or major repair, the individual water supply system shall be purged of deleterious matter and disinfected in accordance with Section 610.

602.3.5 Pumps. Pumps shall be rated for the transport of potable water. Pumps in an individual water supply system shall be constructed and installed so as to prevent contamination from entering a potable water supply through the pump units. Pumps shall be sealed to the well casing or covered with a water-tight seal. Pumps shall be designed to maintain a prime and installed such that ready access is provided to the pump parts of the entire assembly for repairs.

602.3.5.1 Pump enclosure. The pump room or enclosure around a well pump shall be drained and protected from freezing by heating or other approved means. Where pumps are installed in basements, such pumps shall be mounted on a block or shelf not less than 18 inches above the basement floor. Well pits shall be prohibited.

SECTION 603 WATER SERVICE

603.1 Size of water service pipe. The water service pipe shall be sized to supply water to the structure in the quantities and at the pressures required in this Code. The minimum diameter of a water service pipe shall be $\frac{3}{4}$ inch.

603.2 Separation of water service and building sewer/drain. Water service pipe and the building sewer shall be separated by 5 feet of undisturbed or compacted earth.

Exception: The required separation distance shall not apply where the bottom of the water service pipe, within 5 feet of the sewer, is a minimum of 12 inches above the top of the highest point of the sewer and the pipe materials conform to Subsection 703.1.

603.2.1 Water service near sources of pollution. Potable water service pipes shall not be located in, under or above cesspools, septic tanks, septic tank drainage fields or seepage pits. (See Subsection 605.2 for soil and ground water conditions.)

SECTION 604 DESIGN OF BUILDING WATER DISTRIBUTION SYSTEM

604.1 General. The design of the water distribution system shall conform to accepted engineering practice. Methods utilized to determine pipe sizes shall be approved.

604.2 System interconnection. At the points of interconnection between the hot and cold water supply piping systems, and the individual fixtures, appliances or devices, provisions shall be made to prevent flow between such piping systems.

604.3 Water distribution system design criteria. The water distribution system shall be designed, and pipe sizes shall be selected, such that, under conditions of peak demand, the capacities at the fixture supply pipe outlets shall not be less than shown in Table 604.3. The minimum flow rate and flow pressure provided to fixtures and appliances not listed in Table 604.3 shall be in accordance with the manufacturer's installation instructions.

**TABLE 604.3
WATER DISTRIBUTION SYSTEM DESIGN CRITERIA REQUIRED
CAPACITIES AT FIXTURE SUPPLY PIPE OUTLETS**

FIXTURE SUPPLY OUTLET SERVING	FLOW RATE ^a (gpm)	FLOW PRESSURE (psi)
Bathtub	4.75	8
Bidet	2.75	4
Combination fixture	4.75	8
Dishwasher, residential	2.75	8
Drinking fountain	0.75	8
Laundry tray	4.75	8
Lavatory	2.75	8
Shower	3.75	8
Shower, temperature controlled	3.75	20
Sillcock, hose bibb	5.75	8
Sink, residential	2.5	8
Sink, service	3.75	8
Urinal, valve	15.75	15
Water closet, blow out, flushometer valve	35.75	25
Water closet, flushometer tank	1.6	15
Water closet, siphonic, flushometer valve	25.75	15
Water closet, tank, close coupled	3.75	8
Water closet, tank, one piece	6.75	20

a. For additional requirements for flow rates and quantities, see Subsection 604.4.

604.4 Maximum flow and water consumption. The maximum water consumption flow rates and quantities for all plumbing fixtures and fixture fittings shall be in accordance with Table 604.4.

Exceptions:

1. Blowout design fixtures.
2. Vegetable sprays.
3. Clinical sinks.
4. Service sinks.
5. Emergency showers.

**TABLE 604.4
MAXIMUM FLOW RATES AND CONSUMPTION
FOR PLUMBING FIXTURES AND FIXTURE FITTINGS**

PLUMBING FIXTURE OR FIXTURE FITTING	MAXIMUM FLOW RATE OR QUANTITY ^b
Lavatory, private	1.6 gpm at 80 psi
Lavatory, public	0.5 gpm at 80 psi
Lavatory, public, metering or self-closing	0.25 gallon per metering cycle
Shower head ^a	2.5 gpm at 80 psi
Sink faucet	1.5 gpm at 60 psi
Urinal	0.5 gallon per flush cycle
Water closet	1.6 gallons per flush cycle

a. A hand-held shower spray is a shower head.

b. Consumption tolerances shall be determined from referenced standards.

604.5 Size of fixture supply. The minimum size of a fixture supply pipe shall be as shown in Table 604.5. The fixture supply pipe shall not terminate more than 30 inches from the point of connection to the fixture. A reduced-size flexible connector installed between the supply pipe and fixture shall be of an approved type. The supply pipe shall extend to the floor or wall adjacent to the fixture. The minimum size of individual distribution lines utilized in parallel water distribution systems shall be as shown in Table 604.5.

**TABLE 604.5
MINIMUM SIZES OF FIXTURE WATER SUPPLY PIPES**

FIXTURE	MINIMUM PIPE SIZE (inch)
Bathtubs (60" y 32" and smaller) ^a	1/2
Bathtubs (larger than 60" y 32")	1/2
Bidet	3/8
Combination sink and tray	1/2
Dishwasher, domestic ^a	1/2
Drinking fountain	3/8
Hose bibbs	1/2
Kitchen sink ^a	1/2
Laundry, 1, 2 or 3 compartments ^a	1/2
Lavatory	3/8
Shower, single head ^a	1/2
Sinks, flushing rim	3/4
Sinks, service	1/2
Urinal, flush tank	1/2
Urinal, flush valve	3/4
Wall hydrant	1/2
Water closet, flush tank	3/8
Water closet, flush valve	1
Water closet, flushometer tank	3/8
Water closet, one piece ^a	1/2

a. Where the developed length of the distribution line is 60 feet or less, and the available pressure at the meter is a minimum of 35 psi, the minimum size of an individual distribution line supplied from a manifold and installed as part of a parallel water distribution system shall be one nominal tube size smaller than the sizes indicated.

604.6 Variable street pressures. Where street water main pressures fluctuate, the building water distribution system shall be designed for the minimum pressure available.

604.7 Inadequate water pressure. Wherever water pressure from the street main or other source of supply is insufficient to provide flow pressures at fixture outlets as required under Subsection 604.3, a water pressure booster system conforming to Subsection 606.5 shall be installed on the building water supply system.

604.8 Water pressure-reducing valve or regulator. Where water pressure within a building exceeds 80 pounds per square inch (psi) static, an approved water pressure-reducing valve conforming to ASSE 1003 with strainer shall be installed to reduce the pressure in the building water distribution piping to 80 psi static or less.

Exception: Service lines to sill cocks and outside hydrants, and main supply risers where pressure from the mains is reduced to 80 psi or less at individual fixtures.

604.8.1 Valve design. The pressure-reducing valve shall be designed to remain open to permit uninterrupted water flow in case of valve failure.

604.8.2 Repair and removal. All water pressure-reducing valves, regulators and strainers shall be so constructed and installed as to permit repair or removal of parts without breaking a pipeline or removing the valve and strainer from the pipeline.

604.9 Water hammer. The flow velocity of the water distribution system shall be controlled to reduce the possibility of water hammer. A water-hammer arrestor shall be installed where quick-closing valves are utilized, unless otherwise approved. The arrestor shall be located within an effective range of the quick-closing valve. Water-hammer arrestors shall conform to ASSE 1010. Water-hammer arrestors shall be installed in accordance with the manufacturer's installation instructions.

604.10 Parallel water distribution system manifolds. Hot water and cold water manifolds installed with parallel connected individual distribution lines to each fixture or fixture fitting shall be designed in accordance with Subsections 604.10.1 through 604.10.3.

604.10.1 Manifold sizing. Hot water and cold water manifolds shall be sized in accordance with Table 604.10.1. The total gallons per minute (gpm) is the demand of all outlets supplied.

**TABLE 604.10.1
MANIFOLD SIZING**

NOMINAL SIZE INTERNAL DIAMETER (inches)	MAXIMUM DEMAND (gpm)	
	Velocity at 4 feet per second	Velocity at 8 feet per second
1/2	2	5
3/4	6	11
1	10	20
1 1/4	15	31
1 1/2	22	44

604.10.2 Valves. Individual fixture shutoff valves installed at the manifold shall be identified as to the fixture being supplied.

604.10.3 Access. Access shall be provided to manifolds.

604.11 Buildings other than dwelling or dwelling units. Shutoff valves shall be installed that permit the water supply to all fixtures and equipment in each separate room to be shut off without interference with the water supply to any other room or portion of the building, or each individual fixture and each piece of equipment shall have a shutoff valve or integral stop that will permit each fixture and piece of equipment to be shut off without interfering with the water supply to other fixtures or equipment.

604.11.1 Supply branch lines. Each water supply branch line shall have a shutoff valve installed so as to isolate all fixtures and all pieces of equipment supplied by the branch line. The shutoff valve shall be installed in a labeled and accessible location as close to the supply main connection as practical.

SECTION 605 MATERIALS, JOINTS AND CONNECTIONS

605.1 Water compatibility. Water service pipe and water distribution pipe shall be resistant to corrosive action and degrading action from the potable water supplied by the water purveyor or individual water supply system.

605.2 Soil and ground water. The installation of a water service pipe shall be prohibited in soil and ground water contaminated with solvents, fuels, organic compounds or other detrimental materials causing permeation, corrosion, degradation or structural failure of the piping material. Where detrimental conditions are suspected, a chemical analysis of the soil and ground water conditions shall be required to ascertain the acceptability of the water service material for the specific installation. Where detrimental conditions exist, approved alternative materials or routing shall be required.

605.3 Lead content of water supply pipe and fittings. Pipe and pipe fittings, including valves and faucets, utilized in the water supply system shall have a maximum of 8 percent lead content.

605.4 Water service pipe. Water service pipe shall conform to NSF 61 and one of the standards listed in Table 605.4. All water service pipe or tubing, installed underground and outside of the structure, shall have a minimum working pressure rating of 160 psi at 73.4°F. Where the water pressure exceeds 160 psi, piping material shall have a minimum rated working pressure equal to the highest available pressure. Plastic water service piping shall terminate within 5 feet inside the point of entry into a building. All ductile iron water pipe shall be cement-mortar lined in accordance with AWWA C104.

**TABLE 605.4
WATER SERVICE PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D1527; ASTM D2282
Asbestos-cement pipe	ASTM C296
Brass pipe	ASTM B43
Copper or copper-alloy pipe	ASTM B42; ASTM B302
Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM)	ASTM B75; ASTM B88; ASTM B251; ASTM B447
Chlorinated polyvinyl chloride (CPVC) plastic pipe	ASTM D2846; ASTM F441; ASTM F442; CSA B137.6
Ductile iron water pipe	AWWA C115; AWWA C151
Galvanized steel pipe	ASTM A53
Polybutylene (PB) plastic pipe and tubing	ASTM D2662; ASTM D2666; ASTM D3309; CSA B137.8
Polyethylene (PE) plastic pipe	ASTM D2239; CSA CAN/CSA-B137.1
Polyethylene (PE) plastic tubing	ASTM D2737; CSA B137.1
Cross-linked polyethylene (PEX) plastic tubing	ASTM F876; ASTM F877; CSA CAN/CSA-B137.5
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	ASTM F1281; CSA CAN/CSA-B137.10
Polyethylene/aluminum/polyethylene (PE-AL-PE) pipe	ASTM F1282; CSA CAN/CSA-B137.9
Polyvinyl chloride (PVC) plastic pipe	ASTM D1785; ASTM D2241; ASTM D2672; CSA CAN/CSA-B137.3
Stainless steel pipe (Type 304/304L)	ASTM A312; ASTM A778
Stainless steel pipe (Type 316/316L)	ASTM A312; ASTM A778

605.4.1 Dual check-valve-type backflow preventer.

Where a dual check-valve backflow preventer is installed on the water supply system, it shall comply with ASSE 1024.

605.5 Water distribution pipe. Water distribution pipe shall conform to NSF 61 and one of the standards listed in Table 605.5. All hot water distribution pipe and tubing shall have a minimum pressure rating of 100 psi at 180°F.

605.6 Fittings. Pipe fittings shall be approved for installation with the piping material installed, and shall conform to the respective pipe standards or one of the standards listed in Table 605.6. All pipe fittings utilized in water supply systems shall also conform to NSF 61. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing flow in the piping. Ductile and gray iron pipe fittings shall be cement-mortar lined in accordance with AWWA C104.

**TABLE 605.5
WATER DISTRIBUTION PIPE**

MATERIAL	STANDARD
Brass pipe	ASTM B43
Chlorinated polyvinyl chloride (CPVC) plastic pipe and tubing	ASTM D2846; ASTM F441; ASTM F442; CSA B137.6
Copper or copper-alloy pipe	ASTM B42; ASTM B302
Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM)	ASTM B75; ASTM B88; ASTM B251; ASTM B447
Cross-linked polyethylene (PEX) plastic tubing	ASTM F877; CSA CAN/CSA-B137.5
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	ASTM F1281; CSA CAN/CSA-B137.10
Galvanized steel pipe	ASTM A53
Polybutylene (PB) plastic pipe and tubing	ASTM D3309; CSA CAN/CSA-B137.8
Stainless steel pipe (Type 304/304L)	ASTM A312; ASTM A778
Stainless steel pipe (Type 316/316L)	ASTM A312; ASTM A778

**TABLE 605.6
PIPE FITTINGS**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D2468
Cast iron	ASME B16.4; ASME B16.12
Chlorinated polyvinyl chloride (CPVC) plastic	ASTM F437; ASTM F438; ASTM F439
Copper or copper alloy	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; ASME B16.26; ASME B16.29; ASME B16.32
Gray iron and ductile iron	AWWA C110; AWWA C153
Malleable iron	ASME B16.3
Metal insert fittings utilizing a copper crimp ring SDR 9 cross-linked polyethylene (PEX) tubing	ASTM F1807
Polyethylene (PE) plastic	ASTM D2609
Polyvinyl chloride (PVC) plastic	ASTM D2464; ASTM D2466; ASTM D2467; CSA CAN/CSA-B137.2
Steel	ASME B16.9; ASME B16.11; ASME B16.28

605.7 Valves. All valves shall be of the approved type and compatible with the type of piping material installed in the system.

605.8 Manufactured pipe nipples. Manufactured pipe nipples shall conform to one of the standards listed in Table 605.8.

**TABLE 605.8
MANUFACTURED PIPE NIPPLES**

MATERIAL	STANDARD
Steel	ASTM A733
Brass-, copper-, chromium-plated	ASTM B687

605.9 Prohibited joints and connections. The following types of joints and connections shall be prohibited:

- (a) Cement or concrete joints.
- (b) Joints made with fittings not approved for the specific installation.
- (c) Solvent-cement joints between different types of plastic pipe.
- (d) Saddle-type fittings.
- (e) Joints between dissimilar metals without the use of approved fittings.

605.10 ABS Plastic. Joints between ABS plastic pipe or fittings shall comply with Subsections 605.10.1 through 605.10.3.

605.10.1 Mechanical joints. Mechanical joints on water pipes shall be made with an elastomeric seal conforming to ASTM D3139. Mechanical joints shall only be installed in underground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

605.10.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D2235 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D2235. Solvent-cement joints shall be permitted above or below ground.

605.10.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

605.11 Asbestos cement. Joints between asbestos-cement pipe or fittings shall be made with a sleeve coupling of the same composition as the pipe, sealed with an elastomeric ring conforming to ASTM D1869.

605.12 Brass. Joints between brass pipe or fittings shall comply with Subsections 605.12.1 through 605.12.4.

605.12.1 Braze joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

605.12.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

605.12.3 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

605.12.4 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

605.13 Gray iron and ductile iron joints. Joints for gray and ductile iron pipe and fittings shall comply with AWWA C111, and shall be installed in accordance with the manufacturer's installation instructions and Table 605.13.

**TABLE 605.13
LEAD DEPTH FOR CAULKED CAST-IRON PIPE**

PIPE SIZE (inches)	DEPTH OF LEAD (inches)
Up to 20	2 ¹ / ₄
24, 30, 36	2 ¹ / ₂
Larger than 36	3

605.14 Copper pipe. Joints between copper or copper-alloy pipe or fittings shall comply with Subsections 605.14.1 through 605.14.5.

605.14.1 Braze joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

605.14.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

605.14.3 Soldered joints. Solder joints shall be made in accordance with the methods of ASTM B828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. The joining of water supply piping shall be made with lead-free solder and fluxes. "Lead free" shall mean a chemical composition equal to or less than 0.2 percent lead.

605.14.4 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

605.14.5 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

605.15 Copper tubing. Joints between copper or copper-alloy tubing or fittings shall comply with Subsections 605.15.1 through 605.15.4.

605.15.1 Braze joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

605.15.2 Flared joints. Flared joints for water pipe shall be made by a tool designed for that operation.

605.15.3 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

605.15.4 Soldered joints. Solder joints shall be made in accordance with the methods of ASTM B828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. The joining of water supply piping shall be made with lead-free solders and fluxes. "Lead free" shall mean a chemical composition equal to or less than 0.2 percent lead.

605.15.5 Mechanically formed tee connections. Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height not less than three times the thickness of the tube wall.

605.15.5.1 Branch. The branch shall be notched to conform with the inner curve of the run tube and dimpled to insure that penetration of the branch tube into the collar is of sufficient depth for brazing, and that the branch tube does not obstruct the flow in the main line tube.

605.15.5.2 Joints. All joints shall be brazed in accordance with Subsection 605.15.1. Soft-soldered joints shall not be permitted.

605.16 CPVC plastic. Joints between CPVC plastic pipe or fittings shall comply with Subsections 605.16.1 through 605.16.3.

605.16.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

605.16.2 Solvent cementing. Joint surfaces shall be clean and free from moisture and an approved primer shall be applied. Solvent cement, orange in color and conforming to ASTM F493, shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and in accordance with ASTM D2846 or ASTM F493. Solvent-cement joints shall be permitted above or below ground.

Exception: A primer is not required where all of the following conditions apply:

1. The solvent cement used is third-party certified as conforming to ASTM F493.
2. The solvent cement used is yellow in color.
3. The solvent cement is used only for joining 1/2-inch- through 2-inch-diameter CPVC pipe and fittings.
4. The CPVC pipe and fittings are manufactured in accordance with ASTM D2846.

605.16.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe, but the pressure rating of the pipe shall be reduced by 50 percent. Thread by socket-molded fittings

shall be permitted. Approved thread lubricant or tape shall be applied on the male threads only.

605.17 Cross-linked polyethylene plastic. Joints between cross-linked polyethylene plastic tubing or fittings shall comply with Subsections 605.17.1 and 605.17.2.

605.17.1 Flared joints. Flared pipe ends shall be made with a tool designed for that operation.

605.17.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions. Metallic lock rings and insert fittings, as described in ASTM F1807, shall be installed in accordance with the manufacturer's installation instructions.

605.18 Steel. Joints between galvanized steel pipe or fittings shall comply with Subsections 605.18.1 and 605.18.2.

605.18.1 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

605.18.2 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

605.19 Polybutylene plastic. Joints between polybutylene plastic pipe and tubing or fittings shall comply with Subsections 605.19.1 through 605.19.3.

605.19.1 Flared joints. Flared pipe ends shall be made by a tool designed for that operation.

605.19.2 Heat-fusion joints. Joints shall be of the socket-fusion or butt-fusion type. Joint surfaces shall be clean and free from moisture. All joint surfaces shall be heated to melt temperature and joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D2657, ASTM D3309 or CSA CAN3-B137.8.

605.19.3 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions. Metallic lock rings employed with insert fittings, as described in ASTM D3309 or CSA CAN3-B137.8, shall be installed in accordance with the manufacturer's installation instructions.

605.20 Polyethylene plastic. Joints between polyethylene plastic pipe and tubing or fittings shall comply with Subsections 605.20.1 through 605.20.4.

605.20.1 Flared joints. Flared joints shall be permitted where so indicated by the pipe manufacturer. Flared joints shall be made by a tool designed for that operation.

605.20.2 Heat-fusion joints. Joint surfaces shall be clean and free from moisture. All joint surfaces shall be heated to melt temperature and joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D2657.

605.20.3 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

605.20.4 Installation. Polyethylene pipe shall be cut square, with a cutter designed for plastic pipe. Except where joined by heat fusion, pipe ends shall be chamfered

to remove sharp edges. Kinked pipe shall not be installed. The minimum pipe bending radius shall not be less than 30 pipe diameters, or the minimum coil radius, whichever is greater. Piping shall not be bent beyond straightening of the curvature of the coil. Bends shall not be permitted within 10 pipe diameters of any fitting or valve. Stiffener inserts installed with compression-type couplings and fittings shall not extend beyond the clamp or nut of the coupling or fitting.

605.21 PVC plastic. Joints between PVC plastic pipe or fittings shall comply with Subsections 605.21.1 through 605.21.3.

605.21.1 Mechanical joints. Mechanical joints on water pipe shall be made with an elastomeric seal conforming to ASTM D3139. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

605.21.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F656 shall be applied. Solvent cement not purple in color and conforming to ASTM D2564 or CSA CAN/CSA-B137.3 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D2855. Solvent-cement joints shall be permitted above or below ground.

605.21.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe, but the pressure rating of the pipe shall be reduced by 50 percent. Thread by socket-molded fittings shall be permitted. Approved thread lubricant or tape shall be applied on the male threads only.

605.22 Joints between different materials. Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type, or as permitted in Subsections 605.22.1 and 605.22.2. Connectors or adapters shall have an elastomeric seal conforming to ASTM D1869 or ASTM F477. Joints shall be installed in accordance with the manufacturer's installation instructions.

605.22.1 Copper or copper-alloy tubing to galvanized steel pipe. Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass converter fitting or dielectric fitting. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe.

605.22.2 Plastic pipe or tubing to other piping material. Joints between different grades of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting.

SECTION 606 INSTALLATION OF THE BUILDING WATER DISTRIBUTION SYSTEM

606.1 Location of full-open valves. Full-open valves shall be installed in the following locations:

- (a) On the building water service pipe from the public water supply near the curb.
- (b) On the water distribution supply pipe at the entrance into the structure.
- (c) On the discharge side of every water meter.
- (d) On the base of every water riser pipe in occupancies other than multiple-family residential occupancies that are two stories or less in height, and in one- and two-family residential occupancies.
- (e) On the top of every water down-feed pipe in occupancies other than one- and two-family residential occupancies.
- (f) On the entrance to every water supply pipe to a dwelling unit, except where supplying a single fixture equipped with individual stops.
- (g) On the water supply pipe to a gravity or pressurized water tank.
- (h) On the water supply pipe to every water heater.

606.2 Location of shutoff valves. Shutoff valves shall be installed in the following locations:

- (a) On the fixture supply to each plumbing fixture in other than one- and two-family and multiple-family residential occupancies, and other than in individual guest rooms that are provided with unit shutoff valves in hotels, motels, boarding houses and similar occupancies.
- (b) On the water supply pipe to each sillcock.
- (c) On the water supply pipe to each appliance or mechanical equipment.

606.3 Access to valves. Access shall be provided to all required full-open valves and shutoff valves.

606.4 Valve identification. Service and hose bibb valves shall be identified. All other valves installed in locations that are not adjacent to the fixture or appliance shall be identified, indicating the fixture or appliance served.

606.5 Water pressure booster systems. Water pressure booster systems shall be provided as required by Subsections 606.5.1 through 606.5.10.

606.5.1 Water pressure booster systems required. Where the water pressure in the public water main or individual water supply system is insufficient to supply the minimum pressures and quantities specified in this Code, the supply shall be supplemented by an elevated water tank, a hydropneumatic pressure booster system or a water pressure booster pump installed in accordance with Subsection 606.5.5.

606.5.2 Support. All water supply tanks shall be supported in accordance with the *EPCOT Building Code*.

606.5.3 Covers. All water supply tanks shall be covered to keep out unauthorized persons, dirt and vermin. The covers of gravity tanks shall be vented with a return bend vent pipe with an area not less than the area of the down-feed riser pipe, and the vent shall be screened with a corrosion-resistant screen of not less than 16 by 20 mesh per inch.

606.5.4 Overflows for water supply tanks. Each gravity or suction water supply tank shall be provided with an overflow with a diameter not less than that shown in Table 606.5.4. The overflow outlet shall discharge above and within not less than 6 inches of a roof or roof drain, floor or floor drain, or over an open water-supplied fixture. The overflow outlet shall be covered with a corrosion-resistant screen of not less than 16 by 20 mesh per inch and by a 1/4-inch hardware cloth, or shall terminate in a horizontal angle seat check valve. Drainage from overflow pipes shall be directed so as not to freeze on roof walks.

**TABLE 606.5.4
SIZES FOR OVERFLOW PIPES FOR WATER SUPPLY TANKS**

MAXIMUM CAPACITY OF WATER SUPPLY LINE TO TANK (gpm)	DIAMETER OF OVERFLOW PIPE (inches)
0 – 50	2
50 – 150	2½
150 – 200	3
200 – 400	4
400 – 700	5
700 – 1,000	6
Over 1,000	8

606.5.5 Low-pressure cutoff required on booster pumps. A low-pressure cutoff shall be installed on all booster pumps in a water pressure booster system to prevent the creation of a vacuum or negative pressure on the suction side of the pump when a positive pressure of 10 psi or less occurs on the suction side of the pump.

606.5.6 Potable water inlet control and location. Potable water inlets to gravity tanks shall be controlled by a ball cock or other automatic supply valve installed so as to prevent the tank from overflowing. The inlet shall be terminated so as to provide an air gap not less than 4 inches above the overflow.

606.5.7 Tank drain pipes. A valved pipe shall be provided at the lowest point of each tank to permit the emptying of the tank. The tank drain pipe shall discharge as required for overflow pipes and shall not be smaller in size than specified in Table 606.5.7.

**TABLE 606.5.7
SIZE OF DRAIN PIPES FOR WATER TANKS**

TANK CAPACITY (gallons)	DRAIN PIPE (inches)
Up to 750	1
751 to 1,500	1½
1,501 to 3,000	2
3,001 to 5,000	2½
5,001 to 7,500	3
Over 7,500	4

606.5.8 Prohibited location of potable supply tanks. Potable water gravity tanks or manholes of potable water

pressure tanks shall not be located directly under any soil or waste piping, or any source of contamination.

606.5.9 Pressure tanks, vacuum relief. All water pressure tanks shall be provided with a vacuum relief valve at the top of the tank that will operate up to a maximum water pressure of 200 psi and up to a maximum temperature of 200°F. The minimum size of such vacuum relief valve shall be 1/2 inch.

Exception: This Subsection shall not apply to pressurized captive air diaphragm/bladder tanks.

606.5.10 pressure relief for tanks. Every pressure tank in a hydropneumatic pressure booster system shall be protected with a pressure relief valve. The pressure relief valve shall be set at a maximum pressure equal to the rating of the tank. The relief valve shall be installed on the supply pipe to the tank or on the tank. The relief valve shall discharge by gravity to a safe place of disposal.

606.6 Water supply system test. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested in accordance with Section 312.

SECTION 607 HOT WATER SUPPLY SYSTEM

607.1 Where required. In occupied structures, hot water shall be supplied to all plumbing fixtures and equipment utilized for bathing, washing, culinary purposes, cleansing, laundry or building maintenance.

Exceptions:

1. In nonresidential occupancies, tempered water may be supplied for bathing and washing purposes.
2. Tempered water shall be delivered from accessible hand-washing facilities.

607.1.1 Temperature limiting means. A thermostat control for a water heater shall not serve as the temperature limiting means for the purposes of complying with the requirements of this Code for maximum allowable hot or tempered water delivery temperature at fixtures.

607.1.2 Tempered water temperature control. Tempered water shall be supplied through a water temperature limiting device that conforms to ASSE 1070 and shall limit the tempered water to a maximum of 110°F. This provision shall not supersede the requirement for protective shower valves in accordance with Subsection 424.4.

607.2 Hot water supply temperature maintenance. Where the developed length of hot water piping from the source of the hot water supply to the farthest fixture exceeds 100 feet, the hot water supply system shall be provided with a method of maintaining the temperature of hot water to within 100 feet of the fixtures. The methods of maintaining energy efficiency shall be in accordance with the *EPCOT Energy Efficiency Code for Building Construction*.

The flow rate for domestic hot water recirculation systems shall not exceed four 4 feet per second (minimum pipe size shall be 3/4 inch).

607.2.1 Piping insulation. Piping in required return circulation systems shall be insulated to provide a thermal resistance, R , excluding film resistances, of:

$$R = \left[\frac{t_i - t_o}{25} (\text{hr})(\text{ft}^2)^{\circ}\text{F} \right] / \text{Btu}$$

where $t_i - t_o$ is the design temperature differential between the water in the pipe and the surrounding air, in $^{\circ}\text{F}$.

Exception: Pipe insulation is not required where $t_i - t_o$ is 25°F or less.

607.2.2 Pump operation. Where a circulating pump is installed on a return circulation hot water system, the pump shall be arranged to shut off automatically or to allow manual shut off when the hot water system is not in operation.

607.3 Thermal expansion control. A means of controlling increased pressure caused by thermal expansion shall be provided where required in accordance with Subsections 607.3.1 and 607.3.2.

607.3.1 Pressure-reducing valve. For water service system sizes up to and including 2 inches, a device for controlling pressure shall be installed where, because of thermal expansion, the pressure on the downstream side of a pressure-reducing valve exceeds the main supply pressure. A pressure-reducing valve with an integral bypass check valve or other device shall be installed to satisfy this requirement.

607.3.2 Backflow prevention device or check valve. Where a backflow prevention device, check valve or other device is installed on a water supply system utilizing storage water-heating equipment such that thermal expansion causes an increase in pressure, a device for controlling pressure shall be installed.

607.4 Hot Water supply to fixtures. The hot water supply to any fixture shall be installed on the left side of the fixture.

SECTION 608 PROTECTION OF POTABLE WATER SUPPLY

608.1 General. A potable water supply system shall be designed, installed and maintained in such a manner so as to prevent contamination from nonpotable liquids, solids or gases being introduced into the potable water supply through cross connections or any other piping connections to the system. Backflow preventer applications shall conform to Table 608.1, except as specifically stated in Subsections 608.2 through 608.16.9.

608.2 Plumbing fixtures. The supply lines or fittings for every plumbing fixture shall be installed so as to prevent backflow.

608.3 Devices, appurtenances, appliances and apparatus. All devices, appurtenances, appliances and apparatus intended to serve some special function, such as sterilization, distillation, processing, cooling, or storage of ice or foods, and that connect to the water supply system, shall be provided with protection against backflow and contamination of the water supply system. Water pumps, filters, softeners, tanks, and all other appliances and devices that handle or treat potable water shall be protected against contamination.

608.3.1 Special equipment, water supply protection. The water supply for hospital fixtures shall be protected against backflow with a reduced pressure principle backflow preventer, an atmospheric or spillproof vacuum breaker, or an air gap. Vacuum breakers for hose connections in health care or laboratory areas shall not be less than 6 feet above the floor.

608.4 Water service piping. Water service piping shall be protected in accordance with Subsections 603.2 and 603.2.1.

608.5 Chemicals and other substances. Chemicals and other substances that produce either toxic conditions, taste, odor or discoloration in a potable water system shall not be introduced into, or utilized in, such systems.

608.6 Cross-connection control. Cross connections shall be prohibited, except where approved protective devices are installed.

608.6.1 Private water supplies. Cross connections between a private water supply and a potable public supply shall be prohibited.

608.7 Stop-and-waste valves prohibited. Combination stop-and-waste valves or cocks shall not be installed underground.

608.8 Identification of potable and nonpotable water. In all buildings where two or more water distribution systems, one potable water and the other nonpotable water, are installed, each system shall be identified either by color marking or metal tags as required by ASME A13.1.

608.9 Reutilization prohibited. Water utilized for the cooling of equipment or other processes shall not be returned to the potable water system. Such water shall be discharged into a drainage system through an air gap or shall be utilized for nonpotable purposes.

608.10 Reuse of piping. Piping that has been utilized for any purpose other than conveying potable water shall not be utilized for conveying potable water.

608.11 Painting of water tanks. The interior surface of a potable water tank shall not be lined, painted or repaired with any material that changes the taste, odor, color or potability of the water supply when the tank is placed in, or returned to, service.

608.12 Pumps and other appliances. Water pumps, filters, softeners, tanks and all other devices that handle or treat potable water shall be protected against contamination.

608.13 Backflow protection. Means of protection against backflow shall be provided in accordance with Subsections 608.13.1 through 608.13.9.

608.13.1 Air gap. The minimum required air gap shall be measured vertically from the lowest end of a potable water outlet to the flood level rim of the fixture or receptacle into which such potable water outlet discharges.

608.13.2 Reduced pressure principle backflow preventers. Reduced pressure principle backflow preventers shall conform to ASSE 1013, AWWA C511 or CSA CAN/CSA-B64.4. Reduced pressure detector assembly backflow preventers shall conform to ASSE 1047. These devices shall be permitted to be installed where subject to continuous pressure conditions. The relief opening shall discharge by air gap and shall be prevented from being submerged.

**TABLE 608.1
APPLICATION OF BACKFLOW PREVENTERS**

DEVICE	DEGREE OF HAZARD ^a	APPLICATION ^b	APPLICABLE STANDARDS
Air gap	High or low hazard	Backsiphonage or backpressure	ASME A112.1.2
Air gap fittings for use with plumbing fixtures, appliances and appurtenances	High or low hazard	Backsiphonage or backpressure	ASME A112.1.3
Anti-siphon-type fill valves for gravity water closet flush tanks	High hazard	Backsiphonage only	ASSE 1002; CSA B125
Backflow preventer for carbonated beverage machines	Low hazard	Backsiphonage or backpressure Sizes $\frac{1}{4}$ " – $\frac{3}{8}$ "	ASSE 1002; CSA B64.3.1
Backflow preventer with intermediate atmospheric vents	Low hazard	Backsiphonage or backpressure Sizes $\frac{1}{4}$ " – $\frac{3}{4}$ "	ASSE 1012; CSA B64.3
Barometric loop	High or low hazard	Backsiphonage only	(see Subsection 608.13.4)
Double check backflow prevention assembly and double check fire protection backflow prevention assembly	Low hazard	Backsiphonage or backpressure Sizes $\frac{3}{8}$ " – 16"	ASSE 1015; AWWA C510; CSA B64.5; CSA B64.5.1
Double check detector fire protection backflow prevention assemblies	Low hazard	Backsiphonage or backpressure (Fire sprinkler systems) Sizes 2" – 16"	ASSE 1048
Dual-check-valve-type backflow preventer	Low hazard	Backpressure or backsiphonage Sizes $\frac{1}{4}$ " – 1"	ASSE 1024; CSA B64.6
Hose connection backflow preventer	High or low hazard	Low-head backpressure, rated working pressure, backpressure or backsiphonage Sizes $\frac{1}{2}$ " – 1"	ASSE 1052; CSA B64.2.1.1
Hose connection vacuum breaker	High or low hazard	Low-head backpressure or backsiphonage Sizes $\frac{1}{2}$ ", $\frac{3}{4}$ ", 1"	ASSE 1011; CSA B64.2; CSA B64.2.1
Laboratory faucet backflow preventer	High or low hazard	Low-head backpressure or backsiphonage	ASSE 1035; CSA B64.7
Pipe-applied atmospheric-type vacuum breaker	High or low hazard	Backsiphonage only Sizes $\frac{1}{4}$ " – 4"	ASSE 1001; CSA B64.1.1
Pressure vacuum breaker assembly	High or low hazard	Backsiphonage only Sizes $\frac{1}{2}$ " – 2"	ASSE 1020; CSA B64.1.2
Reduced pressure principle backflow preventer and reduced pressure principle fire protection backflow preventer	High or low hazard	Backpressure or backsiphonage Sizes $\frac{3}{8}$ " – 16"	ASSE 1013; AWWA C511; CSA B64.4; CSA B64.4.1
Reduced pressure detector fire protection backflow prevention assemblies	High or low hazard	Backsiphonage or backpressure (Fire sprinkler systems)	ASSE 1047
Spillproof vacuum breaker	High or low hazard	Backsiphonage only Sizes $\frac{3}{4}$ " – 2"	ASSE 1056
Vacuum breaker wall hydrants, frost-resistant, automatic-draining type	High or low hazard	Low-head backpressure or backsiphonage Sizes $\frac{3}{4}$ ", 1"	ASSE 1019; CSA B64.2.2

- a. Low hazard—See Pollution (Section 202).
 High hazard—See Contamination (Section 202).
 b. See Backpressure (Section 202).
 See Backpressure, Low Head (Section 202).
 See Backsiphonage (Section 202).

608.13.3 Backflow preventer with intermediate atmospheric vent. Backflow preventers with intermediate atmospheric vents shall conform to ASSE 1012 or CSA CAN/CSA-B64.3. These devices shall be permitted to be installed where subject to continuous pressure conditions. The relief opening shall discharge by air gap and shall be prevented from being submerged.

608.13.4 Barometric loop. Barometric loops shall precede the point of connection and shall extend vertically to a height of 35 feet. A barometric loop shall only be utilized as an atmospheric-type or pressure-type vacuum breaker.

608.13.5 Pressure-type vacuum breakers. Pressure-type vacuum breakers shall conform to ASSE 1020 and spillproof vacuum breakers shall comply with ASSE 1056. These devices are designed for installation under continuous pressure conditions when the critical level is installed at the required height. Pressure-type vacuum breakers shall not be installed in locations where spillage could cause damage to the structure.

608.13.6 Atmospheric-type vacuum breakers. Pipe-applied atmospheric-type vacuum breakers shall conform to ASSE 1001 or CSA CAN/CSA-B64.1.1. Hose-connection vacuum breakers shall conform to ASSE 1011, ASSE 1019, ASSE 1035, ASSE 1052, CSA B64.7, CSA CAN/CSA-B64.2 or CSA CAN/CSA-B64.2.2. These devices shall operate under normal atmospheric pressure when the critical level is installed at the required height.

608.13.7 Double check-valve assemblies. Double check-valve assemblies shall conform to ASSE 1015 or AWWA C510. Double-detector check-valve assemblies shall conform to ASSE 1048. These devices shall be capable of operating under continuous pressure conditions.

608.13.8 Spillproof vacuum breakers. Spillproof vacuum breakers shall conform to ASSE 1056. These devices are designed for installation under continuous pressure

conditions when the critical level is installed at the required height.

608.13.9 Chemical dispenser backflow devices. Backflow devices for chemical dispensers shall comply with ASSE 1055.

608.14 Location of backflow preventers. Access shall be provided to backflow preventers as specified by the installation instructions of the approved manufacturer.

608.14.1 Outdoor enclosures for backflow prevention devices. Outdoor enclosures for backflow prevention devices shall comply with ASSE 1060.

608.15 Protection of potable water outlets. All potable water openings and outlets shall be protected against backflow in accordance with Subsection 608.15.1, 608.15.2, 608.15.3, 608.15.4, 608.15.4.1 or 608.15.4.2.

608.15.1 Protection by air gap. Openings and outlets shall be protected by an air gap between the opening and the fixture flood level rim as specified in Table 608.15.1. Openings and outlets equipped for hose connection shall be protected by means other than an air gap.

608.15.2 Protection by a reduced pressure principle backflow preventer. Openings and outlets shall be protected by a reduced pressure principle backflow preventer.

608.15.3 Protection by a backflow preventer with intermediate atmospheric vent. Openings and outlets shall be protected by a backflow preventer with an intermediate atmospheric vent.

608.15.4 Protection by a vacuum breaker. Openings and outlets shall be protected by atmospheric-type or pressure-type vacuum breakers. The critical level of the vacuum breaker shall be set a minimum of 6 inches above the flood level rim of the fixture or device. Ball cocks shall be set in accordance with Subsection 425.3.1. Vacuum breakers shall not be installed under exhaust hoods or similar loca-

**TABLE 608.15.1
MINIMUM REQUIRED AIR GAPS**

FIXTURE	MINIMUM AIR GAP	
	Away from a wall ^a (inches)	Close to a wall (inches)
Lavatories and other fixtures with effective openings not greater than 1/2 inch in diameter	1	1 1/2
Sink, laundry trays, gooseneck back faucets and other fixtures with effective openings not greater than 3/4 inch in diameter	1 1/2	2 1/2
Over-rim bath fillers and other fixtures with effective openings not greater than 1 inch in diameter	2	3
Drinking water fountains, single orifice not greater than 7/16 inch in diameter or multiple orifices with a total area of 0.150 square inch (area of circle 7/16 inch in diameter)	1	1 1/2
Effective openings greater than 1 inch	Two times the diameter of the effective opening	Three times the diameter of the effective opening

a. Applicable where walls or obstructions are spaced from the nearest inside edge of the spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the diameter of the effective opening for two intersecting walls.

tions that will contain toxic fumes or vapors. Pipe-applied vacuum breakers shall be installed not less than 6 inches above the flood level rim of the fixture, receptor or device served.

608.15.4.1 Deck-mounted and integral vacuum breakers. Approved deck-mounted or equipment-mounted vacuum breakers and faucets with integral atmospheric or spillproof vacuum breakers shall be installed in accordance with the manufacturer's installation instructions and the requirements for labeling with the critical level not less than 1 inch above the flood level rim.

608.15.4.2 Hose connections. Sillcocks, hose bibbs, wall hydrants and other openings with a hose connection shall be protected by an atmospheric-type or pressure-type vacuum breaker, or a permanently attached hose-connection vacuum breaker.

Exceptions:

1. This Subsection shall not apply to water heater and boiler drain valves that are provided with hose-connection threads and that are intended only for tank or vessel draining.
2. This Subsection shall not apply to water supply valves intended for the connection of clothes washing machines where backflow prevention is otherwise provided or is integral with the machine.

608.15.4.3 Fittings with hose-connected outlets. Plumbing fixtures with hose-connected outlets shall have backflow protection in compliance with ASME A112.18.3.

608.16 Connections to the potable water system. Connections to the potable water system shall conform to Subsections 608.16.1 through 608.16.10.

608.16.1 Beverage dispensers. The water supply connection to carbonated beverage dispensers shall be protected against backflow by a double check valve with an intermediate atmospheric vent conforming to ASSE 1012 or ASSE 1022. The double check valve with an intermediate atmospheric vent device and the piping downstream therefrom shall not be affected by carbon dioxide gas. Secondary protection in the form of a dual check valve conforming to ASSE 1032 shall be installed on the beverage-dispensing equipment.

608.16.2 Connections to boilers. The potable supply to the boiler shall be equipped with a backflow preventer with an intermediate atmospheric vent complying with ASSE 1012 or CSA CAN/CSA-B64.3. Where conditioning chemicals are introduced into the system, the potable water connection shall be protected by an air gap or a reduced pressure principle backflow preventer, complying with ASSE 1013, AWWA C511 or CSA CAN/CSA-B64.4.

608.16.3 Heat exchangers. Heat exchangers utilizing an essentially toxic transfer fluid shall be separated from the potable water by double-wall construction. An air gap open to the atmosphere shall be provided between the two walls. Heat exchangers utilizing an essentially nontoxic

transfer fluid shall be permitted to be of single-wall construction.

608.16.4 Connections to automatic fire sprinkler systems and standpipe systems. The potable water supply to automatic fire sprinkler and standpipe systems shall be protected against backflow by a double check-valve assembly or a reduced pressure principle backflow preventer.

Exceptions:

1. Where systems are installed as a portion of the water distribution system in accordance with the requirements of this Code and are not provided with a fire department connection, isolation of the water supply system shall not be required.
2. Isolation of the water distribution system is not required for deluge, preaction or dry-pipe systems.

608.16.4.1 Additives or nonpotable source. Where systems contain chemical additives or antifreeze, or where systems are connected to a nonpotable secondary water supply, the potable water supply shall be protected against backflow by a reduced pressure principle backflow preventer. Where chemical additives or antifreeze are added to only a portion of an automatic fire sprinkler or standpipe system, the reduced pressure principle backflow preventer shall be permitted to be located so as to isolate that portion of the system.

608.16.5 Connections to lawn irrigation systems. The potable water supply to lawn irrigation systems shall be protected against backflow by an atmospheric-type vacuum breaker, a pressure-type vacuum breaker or a reduced pressure principle backflow preventer. A valve shall not be installed downstream from an atmospheric vacuum breaker. Where chemicals are introduced into the system, the potable water supply shall be protected against backflow by a reduced pressure principle backflow preventer.

608.16.6 Connections subject to backpressure. Where a potable water connection is made to a nonpotable line, fixture, tank, vat, pump or other equipment subject to backpressure, the potable water connection shall be protected by a reduced pressure principle backflow preventer.

608.16.7 Chemical dispensers. Where chemical dispensers connect to the water distribution system, the water supply system shall be protected against backflow in accordance with Subsection 608.13.1, 608.13.2, 608.13.3, 608.13.5, 608.13.6 or 608.13.8 or 608.13.9.

608.16.8 Portable cleaning equipment. Where portable cleaning equipment connects to the water distribution system, the water supply system shall be protected against backflow in accordance with Subsection 608.13.1, 608.13.2, 608.13.3, 608.13.7 or 608.13.8.

608.16.9 Dental pump equipment. Where dental pumping equipment connects to the water distribution system, the water supply system shall be protected against backflow in accordance with Subsection 608.13.1, 608.13.5, 608.13.6 or 608.13.8.

608.16.10 Coffee machines and non-carbonated beverage dispensers. The water supply connection to coffee machines and non-carbonated beverage dispensers shall be protected against backflow by a backflow preventer conforming to ASSE 1022 or by an air gap.

608.17 Protection of individual water supplies. An individual water supply shall be located and constructed so as to be safeguarded against contamination in accordance with Subsections 608.17.1 through 608.17.8.

608.17.1 Well locations. A potable ground water source or pump suction line shall not be located closer to potential sources of contamination than the distances shown in Table 608.17.1. In the event the underlying rock structure is limestone or fragmented shale, the local or state health department shall be consulted on well site location. The distances in Table 608.17.1 constitute minimum separation and shall be increased in areas of creviced rock or limestone, or where the direction of movement of the ground water is from sources of contamination toward the well.

**TABLE 608.17.1
DISTANCE FROM SOURCES OF CONTAMINATION TO PRIVATE
WATER SUPPLIES AND PUMP SUCTION LINES**

SOURCE OF CONTAMINATION	DISTANCE (feet)
Barnyard	100
Farm silo	25
Pasture	100
Pumphouse floor drain of cast-iron draining to ground surface	2
Seeping pits	50
Septic tank	25
Sewer	10
Subsurface disposal fields	50
Subsurface pits	50

608.17.2 Elevation. Well sites shall be positively drained and shall be at higher elevations than potential sources of contamination.

608.17.3 Depth. Private potable well supplies shall not be developed from a water table less than 10 feet below the ground surface.

608.17.4 Water-tight casings. Each well shall be provided with a water-tight casing to a minimum distance of 10 feet below the ground surface. All casings shall extend at least 6 inches above the well platform. The casing shall be large enough to permit the installation of a separate drop pipe. Casings shall be sealed at the bottom in an impermeable stratum or extend several feet into the water-bearing stratum.

608.17.5 Drilled or driven well casings. Drilled or driven well casings shall be of steel or other approved material. Where drilled wells extend into a rock formation, the well casing shall extend to and set firmly in the formation. The annular space between the earth and the outside of the casing shall be filled with cement grout to a minimum dis-

tance of 10 feet below the ground surface. In an instance of casing-to-rock installation, the grout shall extend to the rock surface.

608.17.6 Dug or bored well casings. Dug or bored well casings shall be of water-tight concrete, tile, or galvanized or corrugated metal pipe to a minimum distance of 10 feet below the ground surface. Where the water table is more than 10 feet below the ground surface, the water-tight casing shall extend below the table surface. Well casings for dug wells or bored wells constructed with sections of concrete, tile, or galvanized or corrugated metal pipe shall be surrounded by 6 inches of grout poured into the hole between the outside of the casing and the ground to a minimum depth of 10 feet.

608.17.7 Cover. Every potable water well shall be equipped with an overlapping water-tight cover at the top of the casing well or pipe sleeve such that contaminated water or other substances are prevented from entering the well through the annular opening at the top of the well casing, wall or pipe sleeve. Covers shall extend downward at least 2 inches over the outside of the well casing or wall. A dug well cover shall be provided with a pipe sleeve permitting the withdrawal of the pump suction pipe, cylinder or jet body without disturbing the cover. Where pump sections or discharge pipes enter or leave a well through the side of the casing, the circle of contact shall be water tight.

608.17.8 Drainage. All potable water wells and springs shall be constructed such that surface drainage will be diverted away from the well or spring.

SECTION 609 HEALTH CARE PLUMBING

609.1 Scope. This Section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to the requirements of this Section, in addition to the other requirements of this Code. The provisions of this Section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes, homes for the aged, orphanages, infirmaries, first aid stations, psychiatric facilities, clinics, professional offices of dentists and doctors, mortuaries, educational facilities, surgery, dentistry, research and testing laboratories, establishments manufacturing pharmaceutical drugs and medicines, and other structures with similar apparatus and equipment classified as plumbing.

609.2 Approval. All water supply and water distribution systems shall conform to the requirements of Appendix H, as well as other Sections of this Code.

SECTION 610 DISINFECTION OF POTABLE WATER SYSTEM

610.1 General. New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority or water purveyor having jurisdiction or, in the absence of a prescribed method, the procedure

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described in either AWWA C651 or AWWA C652, or as described in this Section. This requirement shall apply to the “on-site” or “in-plant” fabrication of a system, or to a modular portion of a system.

- (a) The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
- (b) The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (ppm) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 ppm of chlorine and allowed to stand for 3 hours.
- (c) Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
- (d) The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

SECTION 611 DRINKING WATER TREATMENT UNITS

611.1 Design. Drinking water treatment units shall meet the requirements of NSF 42, NSF 44, NSF 53 or NSF 62.

611.2 Reverse osmosis systems. The discharge from a reverse osmosis drinking water treatment unit shall enter the drainage system through an air gap or an air gap device that meets the requirements of NSF 58.

611.3 Connection tubing. The tubing to and from drinking water treatment units shall be of a size and material as recommended by the manufacturer. The tubing shall comply with NSF 14, NSF 42, NSF 44, NSF 53 or NSF 61.

SECTION 612 LAWN SPRINKLERS AND IRRIGATION PIPING SYSTEMS

612.1 Limitations. Lawn sprinklers shall only be installed on re-use water systems where such system is available. Where re-use water is not available, Subsection 608.16.5 shall apply. Lawn sprinklers and irrigation systems shall be equipped with controllers that monitor rainfall to prevent operation when not required.

Exception: Rainfall monitors are not required on re-use water systems. Re-use water systems shall be color code identified in accordance with Subsection 608.8.

SECTION 613 SOLAR SYSTEMS

613.1 Solar systems. The construction, installation, alterations and repair of systems, equipment and appliances intended to utilize solar energy for space heating or cooling, domestic hot water heating, swimming pool heating or process heating shall be in accordance with the *EPCOT Mechanical Code*.

CHAPTER 7

SANITARY DRAINAGE

SECTION 701 GENERAL

701.1 Scope. The provisions of this Chapter shall govern the materials, design, construction and installation of sanitary drainage systems.

701.2 Sewer required. Every building in which plumbing fixtures are installed and every premises having drainage piping shall be connected to a public sewer, where available, or an approved private sewage disposal system.

701.3 Separate sewer connection. Every building having plumbing fixtures installed and intended for human habitation, occupancy or use on premises abutting a street, alley or easement in which there is a public sewer shall have a separate connection with the sewer. Where located on the same lot, multiple buildings shall not be prohibited from connecting to a common building sewer that connects to the public sewer.

701.4 Sewage treatment. Sewage or other waste from a plumbing system that is deleterious to surface or subsurface waters shall not be discharged into the ground or any waterway unless it has first been rendered innocuous through subsection to an approved form of treatment.

701.5 Damage to drainage system or public sewer. Wastes detrimental to the public sewer system or detrimental to the functioning of the sewage-treatment plant shall be treated and disposed of in accordance with Section 1003 as directed by the Building Official.

701.6 Tests. The sanitary drainage system shall be tested in accordance with Section 312.

701.7 Connections. Direct connection of a steam exhaust, blowoff or drip pipe shall not be made with the building drainage system. Waste water, when discharged into the building drainage system, shall be at a temperature not higher than 140°F. When higher temperatures exist, approved cooling methods shall be provided.

701.8 Engineered systems. Engineered sanitary drainage systems shall conform to the provisions of Subsection 103.6 and Section 714.

SECTION 702 MATERIALS

702.1 Above-ground sanitary drainage and vent pipe. Above-ground soil, waste and vent pipe shall conform to one of the standards listed in Table 702.1.

702.2 Underground building sanitary drainage and vent pipe. Underground building sanitary drainage and vent pipe shall conform to one of the standards listed in Table 702.2.

702.3 Building sewer pipe. Building sewer pipe shall conform to one of the standards listed in Table 702.3.

702.4 Fittings. Pipe fittings shall be approved for installation with the piping material installed, and shall conform to the respective pipe standards or one of the standards listed in Table 702.4.

702.5 Chemical waste system. A chemical waste system shall be completely separated from the sanitary drainage system. The chemical waste shall be treated in accordance with Subsection 803.2 before discharging to the sanitary drainage system. Separate drainage systems for chemical wastes and vent pipes shall be of an approved material that is resistant to corrosion and degradation for the concentrations of chemicals involved.

702.6 Carbonated soda sanitary drainage. Cast-iron pipe shall not be used in carbonated soda waste locations.

**TABLE 702.1
ABOVE-GROUND DRAINAGE AND VENT PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D2661; ASTM F628; CSA B181.1
Brass pipe	ASTM B43
Cast-iron pipe	ASTM A74; ASTM A888; CISPI 301
Coextruded composite ABS DWV Sch 40 IPS pipe (solid)	ASTM F1488
Coextruded composite ABS DWV Sch 40 IPS pipe (cellular core)	ASTM F1488
Coextruded composite PVC DWV Sch 40 IPS pipe (solid)	ASTM F1488
Coextruded composite PVC DWV Sch 40 IPS pipe (cellular core)	ASTM F1488
Coextruded composite PVC IPS-DR, PS 140, PS 200 DWV	ASTM F1488
Copper or copper-alloy pipe	ASTM B42; ASTM B302
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B75; ASTM B88; ASTM B251; ASTM B306
Galvanized steel pipe	ASTM A53
Glass pipe	ASTM C1053
Polyolefin pipe	CSA CAN/CSA-B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D2665; ASTM D2949; ASTM F891; ASTM F1488; CSA CAN/CSA-B181.2
Stainless steel drainage systems Types 304 and 316L	ASME/ANSI A112.3.1

**TABLE 702.2
UNDERGROUND BUILDING DRAINAGE AND VENT PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D2661; ASTM F628; CSA B181.1
Cast-iron pipe	ASTM A74; ASTM A888; CISPI 301
Coextruded composite ABS DWV Sch 40 IPS pipe (solid)	ASTM F1488
Coextruded composite ABS DWV Sch 40 IPS pipe (cellular core)	ASTM F1488
Coextruded composite PVC DWV Sch 40 IPS pipe (solid)	ASTM F1488
Coextruded composite PVC DWV Sch 40 IPS pipe (cellular core)	ASTM F1488
Coextruded composite PVC IPS-DR, PS 140, PS 200 DWV	ASTM F1488
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B75; ASTM B88; ASTM B251; ASTM B306
Polyolefin pipe	CSA CAN/CSA-B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D2665; ASTM D2949; ASTM F891; CSA CAN/CSA-B181.2
Stainless steel drainage systems Type 316L	ASME/ANSI A112.3.1

**TABLE 702.3
BUILDING SEWER PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D2661; ASTM D2751; ASTM F628
Cast-iron pipe	ASTM A74; ASTM A888; CISPI 301
Coextruded composite ABS DWV Sch 40 IPS pipe (solid)	ASTM F1488
Coextruded composite ABS DWV Sch 40 IPS pipe (cellular core)	ASTM F1488
Coextruded composite PVC DWV Sch 40 IPS pipe (solid)	ASTM F1488
Coextruded composite PVC DWV Sch 40 IPS pipe (cellular core)	ASTM F1488
Coextruded composite PVC IPS DR-PS DWV, PS 140, PS 200	ASTM F1488
Coextruded composite ABS sewer and drain DR-PS in PS 35, PS 50, PS 100, PS 140, PS 200	ASTM F1488
Coextruded composite PVC sewer and drain DR-PS in PS 35, PS 50, PS 100, PS 140, PS 200	ASTM F1488
Concrete pipe	ASTM C14; ASTM C76; CSA A257.1; CSA CAN/CSA A257.2
Copper or copper-alloy tubing (Type K or L)	ASTM B75; ASTM B88; ASTM B251

(continued)

**TABLE 702.3—continued
BUILDING SEWER PIPE**

MATERIAL	STANDARD
Polyvinyl chloride (PVC) plastic pipe (Type DWV, SDR 26, SDR 35, SDR 41, PS 50 or PS 100)	ASTM D2665; ASTM D2949; ASTM D3034; ASTM F891; CSA B182.2; CSA CAN/CSA-B182.4
Stainless steel drainage systems Type 316L	ASME/ANSI A112.3.1
Vitrified clay pipe	ASTM C4; ASTM C700

**TABLE 702.4
PIPE FITTINGS**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D2661; ASTM D3311; CSA B181.1
Cast iron	ASME B16.4; ASME B16.12; ASTM A74; ASTM A888; CISPI 301
Coextruded composite ABS DWV Sch 40 IPS pipe (solid or cellular core)	ASTM D2661; ASTM D3311; ASTM F628
Coextruded composite PVC DWV Sch 40 pipe IPS-PS in PS 35, PS 50, PS 100, PS 140, PS 200	ASTM D2665; ASTM D3311; ASTM F891
Coextruded composite ABS sewer and drain DR-PS in PS 35, PS 50, PS 100, PS 140, PS 200	ASTM D2751
Coextruded composite PVC sewer and drain DR-PS in PS 35, PS 50, PS 100, PS 140, PS 200	ASTM D3034
Copper or copper alloy	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; ASME B16.26; ASME B16.29; ASME B16.32
Glass	ASTM C1053
Gray iron and ductile iron	AWWA C110
Malleable iron	ASME B16.3
Polyvinyl chloride (PVC) plastic	ASTM D2665; ASTM D3311
Plastic, general	ASTM F409
Stainless steel drainage systems Types 304 and 316L	ASME/ANSI A112.3.1
Steel	ASME B16.9; ASME B16.11; ASME B16.28

SECTION 703 BUILDING SEWER

703.1 Building sewer pipe near the water service. Where the building sewer is installed within 10 feet of the water service, as provided for in Subsection 603.2, the building sewer pipe shall conform to one of the standards for ABS plastic pipe, cast-iron pipe, copper or copper-alloy tubing, or PVC plastic pipe listed in Table 702.3.

703.2 Drainage pipe in filled ground. Where a building sewer or building drain is installed on filled or unstable ground, the drainage pipe shall conform to one of the standards for ABS plastic pipe, cast-iron pipe, copper or copper-alloy tubing, or PVC plastic pipe listed in Table 702.3.

703.3 Sanitary and storm sewers. Where separate systems of sanitary drainage and storm drainage are installed in the same property, the sanitary and storm building sewers or drains shall be permitted to be laid side by side in one trench.

703.4 Existing building sewers and drains. Existing building sewers and drains shall connect with new building sewer and drainage systems only where found by examination and test to conform to the new system in quality of material. The Building Official shall notify the owner to make the changes necessary to conform to this Code.

703.5 Cleanouts on building sewers. Cleanouts on building sewers shall be located as set forth in Section 708.

703.6 Minimum size building sewer. No building sewer shall be less than 4 inches in size with the exception of force lines.

SECTION 704 DRAINAGE PIPING INSTALLATION

704.1 Slope of horizontal drainage piping. Horizontal drainage piping shall be installed in uniform alignment at uniform slopes. The minimum slope of a horizontal drainage pipe shall be in accordance with Table 704.1.

**TABLE 704.1
SLOPE OF HORIZONTAL DRAINAGE PIPE**

SIZE (inches)	MINIMUM SLOPE (inch per foot)
2½ or less	¼
3 to 6	⅛
8 or larger	1/16

704.2 Change in size. The size of the drainage piping shall not be reduced in size in the direction of the flow. A 4-inch by 3-inch water closet connection shall not be considered a reduction in size.

704.3 Connections to offsets and bases of stacks. Horizontal branches shall connect to the bases of stacks at a point located not less than 10 pipe diameters downstream from the stack. Except as prohibited by Subsection 711.2, horizontal branches shall connect to horizontal stack offsets at a point located not less than 10 pipe diameters downstream from the upper stack.

704.4 Future fixtures. Drainage piping for future fixtures shall terminate with an approved cap or plug.

704.5 Dead ends. In the installation or removal of any part of a drainage system, dead ends shall be prohibited. Cleanout extensions and approved future fixture drainage piping shall not be considered dead ends.

704.6 Minimum velocity. Where conditions do not permit building drains and sewers to be laid with a slope as great as that specified in Table 704.1, a lesser slope may be permitted

provided the computed velocity will be not less than 2 feet per second.

SECTION 705 JOINTS

705.1 General. This Section contains provisions applicable to joints specific to sanitary drainage piping.

705.2 ABS plastic. Joints between ABS plastic pipe or fittings shall comply with Subsections 705.2.1 through 705.2.3.

705.2.1 Mechanical joints. Mechanical joints on drainage pipes shall be made with an elastomeric seal conforming to ASTM C1173, ASTM D3212 or CSA CAN/CSA-B602. Mechanical joints shall only be installed in underground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

705.2.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D2235, ASTM D2661, ASTM F628 or CSA CAN/CSA-B181.1. Solvent-cement joints shall be permitted above or below ground.

705.2.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

705.3 Asbestos cement. Joints between asbestos-cement pipe or fittings shall be made with a sleeve coupling of the same composition as the pipe, sealed with an elastomeric ring conforming to ASTM D1869.

705.4 Brass. Joints between brass pipe or fittings shall comply with Subsections 705.4.1 through 705.4.4.

705.4.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

705.4.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

705.4.3 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

705.4.4 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

705.5 Cast iron. Joints between cast-iron pipe or fittings shall comply with Subsections 705.5.1 through 705.5.3.

705.5.1 Caulked joints. Joints for hub and spigot pipe shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation to a depth of not less than 1 inch. The lead shall not recede more than 1/8 inch below the rim of the hub and shall be caulked tight. Paint, varnish or other coatings shall not be permitted on the jointing

material until after the joint has been tested and approved. Lead shall be run in one pouring. Acid-resistant rope and acidproof cement shall be permitted.

705.5.2 Compression gasket joints. Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C564. Gaskets shall be compressed when the pipe is fully inserted.

705.5.3 Mechanical joint coupling. Mechanical joint couplings for hubless pipe and fittings shall comply with ASTM C1277 or CISPI 310. The elastomeric sealing sleeve shall conform to ASTM C564 or CSA CAN/ CSA-B602, and shall be provided with a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's installation instructions.

705.6 Concrete joints. Joints between concrete pipe or fittings shall be made with an elastomeric seal conforming to ASTM C443, ASTM C1173, CSA A257.3 or CSA CAN/ CSA-B602.

705.7 Coextruded composite ABS pipe, joints. Joints between coextruded composite pipe with an ABS outer layer or ABS fittings shall comply with Subsections 705.7.1 and 705.7.2.

705.7.1 Mechanical joints. Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM D3212. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

705.7.2 Solvent cementing. Joint surface shall be clean and free from moisture. Solvent cement that conforms to ASTM D2235 or CSA CAN/CSA-B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D2235, ASTM D2661, ASTM F628 or CSA CAN/ CSA-B181.1. Solvent-cement joints shall be permitted above or below ground.

705.8 Coextruded composite PVC pipe. Joints between coextruded composite pipe with a PVC outer layer or PVC fittings shall comply with Subsections 705.8.1 and 705.8.2.

705.8.1 Mechanical joints. Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM D3212. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

705.8.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F656 shall be applied. Solvent cement not purple in color and conforming to ASTM D2564, CSA CAN/ CSA-B137.3, CSA CAN/CSA-B181.1 or CSA CAN/ CSA-B182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D2855. Solvent-cement joints shall be permitted above or below ground.

705.9 Copper pipe. Joints between copper or copper-alloy pipe or fittings shall comply with Subsections 705.9.1 through 705.9.5.

705.9.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

705.9.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

705.9.3 Soldered joints. Solder joints shall be made in accordance with the methods of ASTM B828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32.

705.9.4 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

705.9.5 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

705.10 Copper tubing. Joints between copper or copper-alloy tubing or fittings shall comply with Subsections 705.10.1 through 705.10.3.

705.10.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

705.10.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

705.10.3 Soldered joints. Solder joints shall be made in accordance with the methods of ASTM B828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32.

705.11 Borosilicate glass joints. Glass-to-glass connections shall be made with a bolted compression-type stainless steel (300 series) coupling with a contoured acid-resistant elastomer compression ring and a fluorocarbon polymer inner seal ring; or with caulked joints in accordance with Subsection 705.11.1.

705.11.1 Caulked joints. Every lead-caulked joint for hub and spigot soil pipe shall be firmly packed with oakum or hemp, and filled with molten lead not less than 1 inch deep and not to extend more than $\frac{1}{8}$ inch below the rim of the hub. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. Acid-resistant rope and acidproof cement shall be permitted.

705.12 Steel. Joints between galvanized steel pipe or fittings shall comply with Subsections 705.12.1 and 705.12.2.

705.12.1 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

705.12.2 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be

installed in accordance with the manufacturer's installation instructions.

705.13 Lead. Joints between lead pipe or fittings shall comply with Subsections 705.13.1 and 705.13.2.

705.13.1 Burned. Burned joints shall be uniformly fused together into one continuous piece. The thickness of the joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe.

705.13.2 Wiped. Joints shall be fully wiped, with an exposed surface on each side of the joint not less than $\frac{3}{4}$ inch. The joint shall be at least $\frac{3}{8}$ inch thick at the thickest point.

705.14 PVC plastic. Joints between PVC plastic pipe or fittings shall comply with Subsections 705.14.1 through 705.14.3.

705.14.1 Mechanical joints. Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C1173, ASTM D3212 or CSA CAN/CSA-B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

705.14.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F656 shall be applied. Solvent cement not purple in color and conforming to ASTM D2564, CSA CAN/CSA-B137.3, CSA CAN/CSA-B181.2 or CSA CAN/CSA-B182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D2855. Solvent-cement joints shall be permitted above or below ground.

705.14.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

705.15 Vitrified clay. Joints between vitrified clay pipe or fittings shall be made with an elastomeric seal conforming to ASTM C425, ASTM C1173 or CSA CAN/CSA-B602.

705.16 Joints between different materials. Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type. Connectors and adapters shall be approved for the application and such joints shall have an elastomeric seal conforming to ASTM C425, ASTM C443, ASTM C564, ASTM C1173, ASTM D1869, ASTM F477, CSA A257.3 or CSA CAN/CSA-B602. Joints shall be installed in accordance with the manufacturer's installation instructions.

705.16.1 Copper or copper-alloy tubing to cast-iron hub pipe. Joints between copper or copper-alloy tubing and cast-iron hub pipe shall be made with a brass ferrule or compression joint. The copper or copper-alloy tubing shall be soldered to the ferrule in an approved manner, and the ferrule shall be joined to the cast-iron hub by a caulked joint or a mechanical compression joint.

705.16.2 Copper or copper-alloy tubing to galvanized steel pipe. Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass converter fitting or dielectric fitting. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe.

705.16.3 Cast-iron pipe to galvanized steel or brass pipe. Joints between cast-iron and galvanized steel or brass pipe shall be made by either caulked or threaded joints or with an approved adapter fitting.

705.16.4 Plastic pipe or tubing to other piping material. Joints between different grades of plastic pipe, or between plastic pipe and other piping material, shall be made with an approved adapter fitting. Joints between plastic pipe and cast-iron hub pipe shall be made by a caulked joint or a mechanical compression joint.

705.16.5 Lead pipe to other piping material. Joints between lead pipe and other piping material shall be made by a wiped joint to a caulking ferrule, soldering nipple or bushing, or shall be made with an approved adapter fitting.

705.16.6 Borosilicate glass to other materials. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal and shall be installed in accordance with the manufacturer's installation instructions.

705.16.7 Stainless steel drainage systems to other materials. Joints between stainless steel drainage systems and other piping materials shall be made with approved mechanical couplings.

705.17 Drainage slip joints. Slip joints shall comply with Subsection 425.2.

705.18 Caulking ferrules. Ferrules shall be of red brass and shall be in accordance with Table 705.18.

705.19 Soldering bushings. Soldering bushings shall be of red brass and shall be in accordance with Table 705.19.

**TABLE 705.18
CAULKING FERRULE SPECIFICATIONS**

PIPE SIZES (inches)	INSIDE DIAMETER (inches)	LENGTH (inches)	MINIMUM WEIGHT EACH
2	2 $\frac{1}{4}$	4 $\frac{1}{2}$	1 pound
3	3 $\frac{1}{4}$	4 $\frac{1}{2}$	1 pound, 12 ounces
4	4 $\frac{1}{4}$	4 $\frac{1}{2}$	2 pounds, 8 ounces

**TABLE 705.19
SOLDERING BUSHING SPECIFICATIONS**

PIPE SIZES (inches)	MINIMUM WEIGHT EACH
1 $\frac{1}{4}$	6 ounces
1 $\frac{1}{2}$	8 ounces
2	14 ounces
2 $\frac{1}{2}$	1 pound, 6 ounces
3	2 pounds
4	3 pounds, 8 ounces

705.20 Stainless steel drainage systems. O-ring joints for stainless steel drainage systems shall be made with an approved elastomeric seal.

SECTION 706 CONNECTIONS BETWEEN DRAINAGE PIPING AND FIXTURES

706.1 Connections and changes in direction. All connections and changes in direction of the sanitary drainage system shall be made with approved drainage fittings. Connections between drainage piping and fixtures shall conform to Section 405.

706.2 Obstructions. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed-drainage type.

706.3 Installation of fittings. Fittings shall be installed to guide sewage and waste in the direction of flow. Change in direction shall be made by fittings installed in accordance with Table 706.3. Change in direction by combination fittings, side inlets or increasers shall be installed in accordance with Table 706.3 based on the pattern of flow created by the fitting. Double sanitary tee patterns shall not receive the discharge of back-to-back water closets and fixtures or appliances with pumping action discharge.

**TABLE 706.3
FITTINGS FOR CHANGE IN DIRECTION**

TYPE OF FITTING PATTERN	CHANGE IN DIRECTION		
	Horizontal to vertical	Vertical to horizontal	Horizontal to horizontal
Sixteenth bend	X	X	X
Eighth bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X ^a	X ^a
Short sweep	X	X ^{a, b}	X ^a
Long sweep	X	X	X
Sanitary tee	X ^c		
Wye	X	X	X
Combination wye and eighth bend	X	X	X

a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.

b. Three inches and larger.

c. For a limitation on double sanitary tees, see Subsection 706.3.

SECTION 707 PROHIBITED JOINTS AND CONNECTIONS

707.1 Prohibited joints. The following types of joints and connections shall be prohibited:

- Cement or concrete joints.
- Mastic or hot-pour bituminous joints.
- Joints made with fittings not approved for the specific installation.
- Joints between different diameter pipes made with elastomeric rolling O-rings.

(e) Solvent-cement joints between different types of plastic pipe.

(f) Saddle-type fittings.

SECTION 708 CLEANOUTS

708.1 Scope. This Section shall govern the size, location, installation and maintenance of drainage pipe cleanouts.

708.2 Cleanout plugs. Cleanout plugs shall be of brass, plastic or other approved materials. Brass cleanout plugs shall be utilized with metallic drain, waste and vent piping only, and shall conform to ASME A112.3.1, ASME A112.36.2 or ASTM A74. Cleanouts with plate-style access covers shall be fitted with corrosion-resisting fasteners. Plastic cleanout plugs shall conform to the requirements of Subsection 702.4. Plugs shall have raised square or countersunk square heads. Countersunk heads shall be installed where raised heads are a trip hazard. Cleanout plugs with borosilicate glass systems shall be of borosilicate glass.

708.3 Where required. Cleanouts shall be located in accordance with Subsections 708.3.1 through 708.3.6.

708.3.1 Horizontal drains within buildings. All horizontal drains shall be provided with cleanouts located not more than 100 feet apart.

708.3.2 Building sewers. All building sewers shall be provided with cleanouts located not more than 100 feet apart measured from the upstream entrance of the cleanout. For building sewers 8 inches and larger, manholes shall be provided and located at each change of direction and at intervals of not more than 400 feet. Manholes and manhole covers shall be of an approved type.

708.3.3 Changes of direction. Cleanouts shall be installed at each change of direction of the building drain or horizontal waste or soil lines greater than 45 degrees. Where more than one change of direction occurs in a run of piping, only one cleanout shall be required for each 40 feet of developed length of the drainage piping.

708.3.4 Base of stack. A cleanout shall be provided at the base of each waste or soil stack.

708.3.5 Building drain and building sewer junction. There shall be a cleanout near the junction of the building drain and the building sewer. The cleanout shall be either inside or outside the building wall and shall be brought up to the finished ground level or to the basement floor level. An approved two-way cleanout is allowed to be used at this location to serve as a required cleanout for both the building drain and building sewer. The cleanout at the junction of the building drain and building sewer shall not be required if the cleanout on a 3-inch-diameter or larger soil stack located within a developed length of 10 feet of the building drain and building sewer connection.

708.3.6 Manholes. Manholes serving a building drain shall have secured gas-tight covers and shall be located in accordance with Subsection 708.8.

708.4 Concealed piping. Cleanouts on concealed piping or piping under a floor slab, or piping in a crawl space of less than 24 inches in height or a plenum, shall be extended through and terminate flush with the finished wall, floor or ground surface, or shall be extended to the outside of the building. Cleanout plugs shall not be covered with cement, plaster or any other permanent finish material. Where it is necessary to conceal a cleanout or to terminate a cleanout in an area subject to vehicular traffic, the covering plate, access door or cleanout shall be of an approved type designed and installed for this purpose.

708.5 Opening direction. Every cleanout shall be installed to open to allow cleaning in the direction of the flow of the drainage pipe or at right angles thereto.

708.6 Prohibited installation. Cleanout openings shall not be utilized for the installation of new fixtures or floor drains, except where approved, and where another cleanout of equal access and capacity is provided.

708.7 Minimum size. Cleanouts shall be the same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, the minimum size of the cleanout shall be 4 inches.

Exception: "P" trap connections with slip joints or ground joint connections, or stack cleanouts that are no more than one pipe diameter smaller than the drain served, shall be approved.

708.8 Clearances. Cleanouts on 6-inch and smaller pipes shall be provided with a clearance of not less than 18 inches for rodding. Cleanouts on 8-inch and larger pipes shall be provided with a clearance of not less than 36 inches for rodding.

708.9 Access. Access shall be provided to all cleanouts.

708.10 Trap cleanouts. Each fixture trap, except those cast integrally or in combination with fixtures in which the trap seal is accessible, or except when a portion of the trap is readily removable for cleaning purposes, shall have an accessible brass trap screw of ample size. Cleanout plugs or caps shall be water tight and gas tight. Nylon plastics may be used as an alternative material.

708.10.1 Seals. Cleanouts on the seal of a trap shall be made tight with a threaded cleanout plug and approved washer. Where borosilicate glass traps are required, slip joints or couplings must have a TFE seal.

SECTION 709 FIXTURE UNITS

709.1 Values for fixtures. Drainage fixture unit values, as given in Table 709.1, designate the relative load weight of dif-

ferent kinds of fixtures that shall be employed in estimating the total load carried by a soil or waste pipe, and shall be used in connection with Tables 710.1(1) and 710.1(2) of sizes for soil, waste and vent pipes for which the permissible load is given in terms of fixture units.

709.2 Fixtures not listed in Table 709.1. Fixtures not listed in Table 709.1 shall have a drainage fixture unit load based on the outlet size of the fixture in accordance with Table 709.2. The minimum trap size for unlisted fixtures shall be the size of the drainage outlet, but not less than 1¼ inches.

709.3 Values for continuous and semi-continuous flow. Drainage fixture unit values for continuous flow into a drainage system shall be computed on the basis that 1 gallon per minute (gpm) of flow is equivalent to two fixture units.

709.4 Values for indirect waste receptor. The drainage fixture unit load of an indirect waste receptor receiving the discharge of indirectly connected fixtures shall be the sum of the drainage fixture unit values of the fixtures that discharge to the receptor, but not less than the drainage fixture unit value given for the indirect waste receptor in Table 709.1 or 709.2.

SECTION 710 DRAINAGE SYSTEM SIZING

710.1 Maximum fixture unit load. The maximum number of drainage fixture units connected to a given size of building sewer, building drain or horizontal branch of the building drain shall be determined using Table 710.1(1). The maximum number of drainage fixture units connected to a given size of horizontal branch or vertical soil or waste stack shall be determined using Table 710.1(2).

710.1.1 Horizontal stack offsets. Horizontal stack offsets shall be sized as required for building drains in accordance with Table 710.1(1), except as required by Subsection 711.4.

710.1.2 Vertical stack offsets. Vertical stack offsets shall be sized as required for straight stacks in accordance with Table 710.1(2), except when required to be sized as a building drain in accordance with Subsection 711.1.1.

710.2 Future fixtures. When provision is made for the future installation of fixtures, those provided for shall be considered in determining the required sizes of drain pipes. Construction to provide for such future installation shall be terminated with an approved cap or plug.

710.3 Underground drainage piping. Any portion of the drainage system installed underground or below a basement or cellar shall not be less than 2 inches in diameter.

SANITARY DRAINAGE

**TABLE 709.1
DRAINAGE FIXTURE UNITS FOR FIXTURES AND GROUPS**

FIXTURE TYPE	DRAINAGE FIXTURE UNIT VALUE AS LOAD FACTORS	MINIMUM SIZE OF TRAP (inches)
Automatic clothes washers, commercial ^a	3	2
Automatic clothes washers, residential	2	2
Bathroom group as defined in Section 202 (1.6 gpf water closet) ^f	5	—
Bathroom group as defined in Section 202 (water closets flushing greater than 1.6 gpf) ^f	6	—
Bathtub ^b (with or without overhead shower or whirlpool attachments)	2	1½
Bidet	2	1¼
Combination sink and tray	2	1½
Dental lavatory	1	1¼
Dental unit or cuspidor	1	1¼
Dishwashing machine ^c , domestic	2	1½
Drinking fountain	½	1¼
Emergency floor drain	0	2
Floor drains	2	2
Kitchen sink, domestic	2	1½
Kitchen sink, domestic with food waste grinder and/or dishwasher	2	1½
Laundry tray (one or two compartments)	2	1½
Lavatory	1	1¼
Shower compartment, domestic	2	2
Sink	2	1½
Urinal	4	Note d
Urinal, 1 gpf or less	2 ^e	Note d
Wash sink (circular or multiple) each set of faucets	2	1½
Water closet, flushometer tank, public or private	4 ^e	Note d
Water closet, private (1.6 gpf)	3 ^e	Note d
Water closet, private (flushing greater than 1.6 gpf)	4 ^e	Note d
Water closet, public (1.6 gpf)	4 ^e	Note d
Water closet, public (flushing greater than 1.6 gpf)	6 ^e	Note d

gpf = Gallon per flush

a. For traps larger than 3 inches, use Table 709.2.

b. A showerhead over a bathtub or whirlpool bathtub attachments does not increase the drainage fixture unit value.

c. See Subsections 709.2 through 709.4 for methods of computing unit value of fixtures not listed in Table 709.1 or for the rating of devices with intermittent flows.

d. Trap size shall be consistent with the fixture outlet size.

e. For the purpose of computing loads on building drains and sewers, water closets or urinals shall not be rated at a lower drainage fixture unit unless the lower values are confirmed by testing.

f. For fixtures added to a dwelling unit bathroom group, add the drainage fixture unit value of those additional fixtures to the bathroom group fixture count.

TABLE 709.2
DRAINAGE FIXTURE UNITS FOR FIXTURE DRAINS OR TRAPS

FIXTURE DRAIN OR TRAP SIZE (inches)	DRAINAGE FIXTURE UNIT VALUE
1 $\frac{1}{4}$	1
1 $\frac{1}{2}$	2
2	3
2 $\frac{1}{2}$	4
3	5
4	6

TABLE 710.1(1)
BUILDING DRAINS AND SEWERS

DIAMETER OF PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS CONNECTED TO ANY PORTION OF THE BUILDING DRAIN OR THE BUILDING SEWER, INCLUDING BRANCHES OF THE BUILDING DRAIN ^a			
	Slope per foot			
	1 $\frac{1}{16}$ inch	1 $\frac{1}{8}$ inch	1 $\frac{1}{4}$ inch	1 $\frac{1}{2}$ inch
1 $\frac{1}{4}$			1	1
1 $\frac{1}{2}$			3	3
2			21	26
2 $\frac{1}{2}$			24	31
3		36	42	50
4		180	216	250
5		390	480	575
6		700	840	1,000
8	1,400	1,600	1,920	2,300
10	2,500	2,900	3,500	4,200
12	3,900	4,600	5,600	6,700
15	7,000	8,300	10,000	12,000

a. The minimum size of any building drain serving a water closet shall be 3 inches.

TABLE 710.1(2)
HORIZONTAL FIXTURE BRANCHES AND STACKS^a

DIAMETER OF PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS			
	Total for a horizontal branch	Stacks ^b		
		Total discharge into one branch interval	Total for stack of three branch intervals or less	Total for stack greater than three branch intervals
1 $\frac{1}{2}$	3	2	4	8
2	6	6	10	24
2 $\frac{1}{2}$	12	9	20	42
3	20	20	48	72
4	160	90	240	500
5	360	200	540	1,100
6	620	350	960	1,900
8	1,400	600	2,200	3,600
10	2,500	1,000	3,800	5,600
12	3,900	1,500	6,000	8,400
15	7,000	Note c	Note c	Note c

a. Does not include branches of the building drain. Refer to Table 710.1(1).

b. Stacks shall be sized based on the total accumulated connected load at each story or branch interval. As the total accumulated connected load

decreases, stacks are permitted to be reduced in size. Stack diameters shall not be reduced to less than one-half of the diameter of the largest stack size required.

c. Sizing load based on design criteria.

SECTION 711 OFFSETS IN DRAINAGE PIPING IN BUILDINGS OF FIVE STORIES OR MORE

711.1 Horizontal branch connections above or below vertical stack offsets. If a horizontal branch connects to the stack within 2 feet above or below a vertical stack offset, and the offset is located more than four branch intervals below the top of the stack, the offset shall be vented in accordance with Section 915.

711.1.1 Omission of vents for vertical stack offsets.

Vents for vertical offsets required by Subsection 711.1 shall not be required where the stack and its offset are sized as a building drain [see Table 710.1(1), Column 5].

711.2 Horizontal branch connections to horizontal stack offsets. When a horizontal stack offset is located more than four branch intervals below the top of the stack, a horizontal branch shall not connect within the horizontal stack offset or within 2 feet above or below such offset.

711.3 Horizontal stack offsets. A stack with a horizontal offset located more than four branch intervals below the top of the stack shall be vented in accordance with Section 914 and sized as follows:

- The portion of the stack above the offset shall be sized as for a vertical stack based on the total number of drainage fixture units above the offset.
- The offset shall be sized in accordance with Subsection 710.1.1.
- The portion of the stack below the offset shall be sized as for the offset or based on the total number of drainage fixture units on the entire stack, whichever is larger [see Table 710.1(2), Column 4].

711.3.1 Omission of vents for horizontal stack offsets.

Vents for horizontal stack offsets required by Subsection 711.3 shall not be required where the stack and its offset is one pipe size larger than required for a building drain [see Table 710.1(1), Column 5], and the entire stack and offset is not less in cross-sectional area than that required for a straight stack plus the area of an offset vent as provided for in Section 915. Omission of offset vents in accordance with this Subsection shall not constitute approval of horizontal branch connections within the offset or within 2 feet above or below the offset.

711.4 Offsets below lowest branch. Where a vertical offset occurs in a soil or waste stack below the lowest horizontal branch, a change in diameter of the stack because of the offset shall not be required. If a horizontal offset occurs in a soil or waste stack below the lowest horizontal branch, the required diameter of the offset and the stack below it shall be determined as for a building drain in accordance with Table 710.1(1).

SECTION 712 SUMPS AND EJECTORS

712.1 Building subdrains. Building subdrains that cannot be discharged to the sewer by gravity flow shall be discharged into a tightly covered and vented sump from which the liquid shall be lifted and discharged into the building gravity drainage system by automatic pumping equipment or other approved method. In other than existing structures, the sump shall not receive drainage from any piping within the building capable of being discharged by gravity to the building sewer.

712.2 Full-open valve required. A full-open valve located on the discharge side of the check valve shall be installed in the pump or ejector discharge piping between the pump or ejector and the gravity drainage system. Access shall be provided to such valves. Such valves shall be located above the sump cover required by Subsection 712.1 or, when the discharge pipe from the ejector is below grade, the valves shall be accessibly located outside the sump below grade in an access pit with a removable access cover.

Exception: In single-family residential buildings, only a check valve shall be required, located on the discharge piping from the sewage pump or ejector.

712.3 Sump design. The sump pump, pit and discharge piping shall conform to the requirements of Subsections 712.3.1 through 712.3.5.

712.3.1 Sump pump. The sump pump capacity and head shall be appropriate to anticipated use requirements.

712.3.2 Sump pit. The sump pit shall be not less than 18 inches in diameter and 24 inches deep, unless otherwise approved. The pit shall be accessible and located such that all drainage flows into the pit by gravity. The sump pit shall be constructed of tile, concrete, steel, plastic or other approved materials. The pit bottom shall be solid and provide permanent support for the pump. The sump pit shall be fitted with a gas-tight removable cover adequate to support anticipated loads in the area of use. The sump pit shall be vented in accordance with Chapter 9.

712.3.3 Discharge piping. Discharge piping shall meet the requirements of Subsection 712.2.

712.3.4 Maximum effluent level. The effluent level control shall be adjusted and maintained at all times to prevent the effluent in the sump from rising to within 2 inches of the invert of the gravity drain inlet into the sump.

712.3.5 Ejector connection to the drainage system. Pumps connected to the drainage system shall connect to the building sewer, or shall connect to a wye fitting in the building drain a minimum of 10 feet from the base of any soil stack, waste stack or fixture drain. Where the discharge line connects into horizontal drainage piping, the connection shall be made through a wye fitting into the top of the drainage piping.

712.4 Sewage pumps and sewage ejectors. A sewage pump or sewage ejector shall automatically discharge the contents of the sump to the building drainage system.

712.4.1 Macerating toilet systems. Macerating toilet systems shall be installed in accordance with the manufacturer's installation instructions.

712.4.2 Capacity. A sewage pump or sewage ejector shall have the capacity and head for the application requirements. Pumps or ejectors that receive the discharge of water closets shall be capable of handling spherical solids with a diameter of up to and including 2 inches. Other pumps or ejectors shall be capable of handling spherical solids with a diameter of up to and including 1 inch. The minimum capacity of a pump or ejector based on the diameter of the discharge pipe shall be in accordance with Table 712.4.1.

Exceptions:

1. Grinder pumps or grinder ejectors that receive the discharge of water closets shall have a minimum discharge opening of 1 $\frac{1}{4}$ inches.
2. Macerating toilet assemblies that serve single water closets shall have a minimum discharge opening of $\frac{3}{4}$ inch.

**TABLE 712.4.1
MINIMUM CAPACITY OF SEWAGE PUMP
OR SEWAGE EJECTOR**

DIAMETER OF THE DISCHARGE PIPE (inches)	CAPACITY OF PUMP OR EJECTOR (gpm)
2	21
2 $\frac{1}{2}$	30
3	46

SECTION 713 HEALTH CARE PLUMBING

713.1 Scope. This Section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to this Section, in addition to the other requirements of this Code. The provisions of this Section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes, homes for the aged, orphanages, infirmaries, first aid stations, psychiatric facilities, clinics, professional offices of dentists and doctors, mortuaries, educational facilities, surgery, dentistry, research and testing laboratories, establishments manufacturing pharmaceutical drugs and medicines, and other structures with similar apparatus and equipment classified as plumbing.

713.2 Approval. All sanitary drainage shall conform to the requirements of Appendix H, as well as other Sections of this Code.

SECTION 714 COMPUTERIZED DRAINAGE DESIGN

714.1 Design of drainage system. The sizing requirements for plumbing drainage systems shall be determined by approved computer program design methods.

714.2 Load on drainage system. The load shall be computed from the simultaneous or sequential discharge conditions from fixtures, appurtenances and appliances, or the peak usage design condition.

714.2.1 Fixture discharge profiles. The discharge profiles for flow rates versus time from fixtures and appliances shall be in accordance with the manufacturer's specifications.

714.3 Selections of drainage pipe sizes. Pipe shall be sized to prevent full-bore flow.

714.3.1 Selecting pipe wall roughness. Pipe size calculations shall be conducted with the pipe wall roughness factor (ks), in accordance with the manufacturer's specifications and as modified for aging roughness factors with deposits and corrosion.

714.3.2 Slope of horizontal drainage piping. Horizontal drainage piping shall be designed and installed at slopes in accordance with Table 704.1.

SECTION 715 BACKWATER VALVES

715.1 Sewage backflow. A backwater valve shall be installed only for plumbing fixtures where the overflow rim of the lowest plumbing fixtures are below the next upstream manhole in the public sewer. Plumbing fixtures with flood rims above the next upstream manhole shall not discharge through the backwater valve.

715.2 Fixture branches. Backwater valves shall be installed in the branch of the building drain that receives only the discharge from fixtures located within such branch and shall be located below ground.

715.3 Material. All bearing parts of backwater valves shall be of corrosion-resistant material. Backwater valves shall comply with ASME A112.14.1, CSA CAN/CSA-B181.1 or CSA CAN/CSA-B181.2.

715.4 Seal. Backwater valves shall be so constructed as to provide a mechanical seal against backflow.

715.5 Diameter. Backwater valves, when fully opened, shall have a capacity not less than that of the pipes in which they are installed.

715.6 Location. Backwater valves shall be installed so that access is provided to the working parts for service and repair.

CHAPTER 8

INDIRECT/SPECIAL WASTE

SECTION 801 GENERAL

801.1 Scope. This Chapter shall govern matters concerning indirect waste piping and special wastes. This Chapter shall further control matters concerning food-handling establishments, sterilizers, clear-water wastes, swimming pools, methods of providing air breaks or air gaps, and neutralizing devices for corrosive wastes.

801.2 Protection. All devices, appurtenances, appliances and apparatus intended to serve some special function, such as sterilization, distillation, processing, cooling, or storage of ice or foods, and that discharge to the drainage system, shall be provided with protection against backflow, flooding, fouling, contamination and stoppage of the drain.

SECTION 802 INDIRECT WASTES

802.1 Where required. Food-handling equipment and clear-water waste shall discharge through an indirect waste pipe as specified in Subsections 802.1.1 through 802.1.5. All health-care-related fixtures, devices and equipment shall discharge to the drainage system through an indirect waste pipe by means of an air gap in accordance with this Chapter and Appendix H. Fixtures not required by this Section to be indirectly connected shall be directly connected to the plumbing system in accordance with Chapter 7.

802.1.1 Food handling. Equipment and fixtures utilized for the storage, preparation and handling of food shall discharge through an indirect waste pipe by means of an air gap.

802.1.2 Floor drains in food storage areas. Floor drains located within walk-in refrigerators or freezers in food service and food establishments shall be indirectly connected to the sanitary drainage system by means of an air gap. Where a floor drain is located within an area subject to freezing, the waste line serving the floor drain shall not be trapped and shall indirectly discharge into a waste receptor located outside of the area subject to freezing.

Exception: Where protected against backflow by a backwater valve, such floor drains shall be indirectly connected to the sanitary drainage system by means of an air break or air gap.

802.1.3 Potable clear-water waste. Where devices and equipment, such as sterilizers and relief valves, discharge potable water to the building drainage system, the discharge shall be through an indirect waste pipe by means of an air gap.

802.1.4 Swimming pools. Where waste water from swimming pools, backwash from filters and water from pool deck drains discharge to the building drainage system, the

discharge shall be through an indirect waste pipe by means of an air gap.

802.1.5 Nonpotable clear-water waste. Where devices and equipment, such as process tanks, filters, drips and boilers, discharge nonpotable water to the building drainage system, the discharge shall be through an indirect waste pipe by means of an air break or air gap.

802.1.6 Domestic dishwashing machines. Domestic dishwashing machines shall discharge indirectly through an air gap or air break into a waste receptor in accordance with Subsection 802.2, or discharge into a wye-branch fitting on the tailpiece of the kitchen sink or the dishwasher connection of a food waste grinder. The waste line of a domestic dishwashing machine discharging into a kitchen sink tailpiece or food waste grinder shall connect to a deck-mounted air gap or the waste line shall rise and be securely fastened to the underside of the sink rim or counter.

802.1.7 Commercial dishwashing machines. The discharge from a commercial dishwashing machine shall be through an air gap or air break into a waste receptor in accordance with Subsection 802.2.

802.1.8 Food utensils, dishes, pots and pans sinks. Sinks, in other than dwelling units, used for the washing, rinsing or sanitizing of utensils, dishes, pots, pans or service ware used in the preparation, serving or eating of food shall discharge indirectly through an air gap or an air break to the drainage system.

802.2 Installation. All indirect waste piping shall discharge through an air gap or air break into a waste receptor or standpipe. Waste receptors and standpipes shall be trapped and vented, and shall connect to the building drainage system. All indirect waste piping that exceeds 2 feet in developed length measured horizontally, or 4 feet in total developed length, shall be trapped.

802.2.1 Air gap. The air gap between the indirect waste pipe and the flood level rim of the waste receptor shall be a minimum of twice the effective opening of the indirect waste pipe.

802.2.2 Air break. An air break shall be provided between the indirect waste pipe and the trap seal of the waste receptor or standpipe.

802.3 Waste receptors. Every waste receptor shall be of an approved type. A removable strainer or basket shall cover the waste outlet of waste receptors. Waste receptors shall be installed in ventilated spaces. Waste receptors shall not be installed in bathrooms or toilet rooms, or in any inaccessible or unventilated space, such as a closet or storeroom. Ready access shall be provided to waste receptors.

802.3.1 Size of receptors. A waste receptor shall be sized for the maximum discharge of all indirect waste pipes

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served by the receptor. Receptors shall be installed to prevent splashing or flooding.

802.3.2 Open hub waste receptors. Waste receptors shall be permitted in the form of a hub or pipe extending not less than 1¹/₄ inches above a water-impervious floor and are not required to have a strainer. Pipe waste receptors shall have an increaser a minimum of two pipe sizes at the point where the indirect waste receptor terminates.

802.3.3 Floor sinks. Floor sinks shall be permitted as indirect waste receptors, provided they have a removable basket strainer or beehive strainer. Floor drains are not acceptable as indirect waste receptors.

Exception: Floor drains with strainers that are 3 inches may be used as an indirect waste receptor, provided a funnel is used as an integral part of the strainer.

802.4 Standpipes. Standpipes shall be individually trapped. Standpipes shall extend a minimum of 18 inches and a maximum of 42 inches above the trap. Access shall be provided to all standpipe traps and drains for rodding.

SECTION 803 SPECIAL WASTES

803.1 Waste water temperature. Steam pipes shall not connect to any part of a drainage or plumbing system, and water greater than 140°F shall not be discharged into any part of a drainage system. Such pipes shall discharge into an indirect waste receptor connected to the drainage system.

803.2 Neutralizing device required for corrosive wastes. Corrosive liquids, spent acids or other harmful chemicals that destroy or injure a drain, sewer, soil or waste pipe; create noxious or toxic fumes; or interfere with sewage treatment processes, shall not be discharged into the plumbing system without being thoroughly diluted, neutralized or treated by passing through an approved dilution or neutralizing device. Such devices shall be automatically provided with a sufficient supply of diluting water or neutralizing medium so as to make the contents noninjurious before discharge into the drainage system. The nature of the corrosive or harmful waste and the method of its treatment or dilution shall be approved prior to installation.

803.3 System design. A chemical drainage and vent system shall be designed and installed in accordance with this Code. Chemical drainage and vent systems shall be completely separated from the sanitary systems. Chemical waste shall not discharge to a sanitary drainage system until such waste has been treated in accordance with Subsection 803.2.

SECTION 804 MATERIALS, JOINTS AND CONNECTIONS

804.1 General. The materials and methods utilized for the construction and installation of indirect waste pipes and systems shall comply with the applicable provisions of Chapter 7.

CHAPTER 9

VENTS

SECTION 901 GENERAL

901.1 Scope. The provisions of this Chapter shall govern the materials, design, construction and installation of vent systems.

901.2 Trap seal protection. The plumbing system shall be provided with a system of vent piping that will permit the admission or emission of air so that the seal of any fixture trap shall not be subjected to a pneumatic pressure differential of more than 1 inch of water.

901.2.1 Venting required. Every trap and trapped fixture shall be vented in accordance with one of the venting methods specified in this Chapter.

901.3 Chemical waste vent system. The vent system for a chemical waste system shall be independent of the sanitary vent system and shall terminate separately through the roof to the open air.

901.4 Use Limitations. The plumbing vent system shall not be utilized for purposes other than the venting of the plumbing system.

901.5 Tests. The vent system shall be tested in accordance with Section 312.

901.6 Engineered systems. Engineered venting systems shall conform to the provisions of Section 918.

SECTION 902 MATERIALS

902.1 Vents. The materials and methods utilized for the construction and installation of venting systems shall comply with the applicable provisions of Section 702.

902.2 Sheet copper. Sheet copper for vent pipe flashings shall conform to ASTM B152 and shall weigh not less than 8 ounces per square foot.

902.3 Sheet lead. Sheet lead for vent pipe flashings shall weigh not less than 3 pounds per square foot for field-constructed flashings and not less than 2½ pounds per square foot for prefabricated flashings.

SECTION 903 VENT STACKS AND STACK VENTS

903.1 Stack required. Every building in which plumbing is installed shall have at least one stack the size of which is not less than one-half of the required size of the building drain. Such stack shall run undiminished in size as directly as possible from the building drain through the open air or vent header that extends to the open air.

903.1.1 Connection to drainage system. A main vent that is a vent stack shall connect to the building drain or to the base of a drainage stack in accordance with Subsection 903.4. A main vent that is a stack vent shall be an extension of the drainage stack.

903.2 Vent stack required. A vent stack shall be required for every drainage stack that is five branch intervals or more.

903.3 Vent termination. Every vent stack or stack vent shall extend outdoors and terminate to the open air.

903.4 Vent connection at base. Every vent stack shall connect to the base of the drainage stack. The vent stack shall connect at or below the lowest horizontal branch. Where the vent stack connects to the building drain, the connection shall be located within 10 pipe diameters downstream of the drainage stack.

903.5 Vent headers. Stack vents and vent stacks connected into a common vent header at the top of the stacks and extending to the open air at one point shall be sized in accordance with the requirements of Subsection 916.1. The number of fixture units shall be the sum of all fixture units on all stacks connected thereto, and the developed length shall be the longest vent length from the intersection at the base of the most distant stack to the vent terminal in the open air, as a direct extension of one stack.

SECTION 904 VENT TERMINALS

904.1 Roof extension. All open vent pipes that extend through a roof shall be terminated at least 6 inches above the roof and not less than 2 inches above the invert of the emergency overflow, except that where a roof is to be used for any purpose other than weather protection, the vent extensions shall be run at least 7 feet above the roof.

904.2 Frost closure. Where the 97½-percent value for outside design temperature is less than 0°F, every vent extension through a roof or wall shall be a minimum of 3 inches in diameter. Any increase in the size of the vent shall be made inside the structure a minimum of 1 foot below the roof or inside the wall.

904.3 Flashings. The juncture of each vent pipe with the roof line shall be made water tight by an approved flashing.

904.4 Prohibited use. Vent terminals shall not be used as a flag pole or to support flag poles, television aerials or similar items, except when the piping has been anchored in an approved manner.

904.5 Location of vent terminal. An open vent terminal from a drainage system shall not be located directly beneath any door, openable window or other air intake opening of the building, or of an adjacent building, and any such vent terminal shall not be within 10 feet horizontally of such an opening unless it is at least 2 feet above the top of such opening.

904.6 Extension through the wall. Vent terminals extending through the wall shall terminate a minimum of 10 feet from the lot line and 10 feet above average ground level. Vent terminals shall not terminate under the overhang of a structure with soffit vents. Sidewall vent terminals shall be protected to

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prevent birds or rodents from entering or blocking the vent opening.

904.7 Extension outside a structure. In climates where the 97 $\frac{1}{2}$ -percent value for outside design temperature is less than 0°F, vent pipes installed on the exterior of the structure shall be protected against freezing by insulation, heat or both.

SECTION 905 VENT CONNECTIONS AND GRADES

905.1 Connection. All individual, branch and circuit vents shall connect to a vent stack, stack vent or extend to the open air.

905.2 Grade. All vent and branch vent pipes shall be so graded and connected as to drain back to the drainage pipe by gravity.

905.3 Vent connection to drainage system. Every dry vent connecting to a horizontal drain shall connect above the centerline of the horizontal drain pipe.

905.4 Vertical rise of vent. Every dry vent shall rise vertically to a minimum of 6 inches above the flood level rim of the highest trap or trapped fixture being vented.

905.5 Height above fixtures. A connection between a vent pipe and a vent stack or stack vent shall be made at least 6 inches above the flood level rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents, relief vents or loop vents shall be at least 6 inches above the flood level rim of the highest fixture served.

905.6 Side inlet. Side inlet closet bends are permitted only in cases where the fixture connecting thereto is vented and in no case shall the inlet be used to vent a bathroom group without being washed by a fixture.

905.7 Vent for future fixtures. Where the drainage piping has been roughed-in for future fixtures, a rough-in connection for a vent shall be installed. The vent size shall be not less than one-half the diameter of the rough-in drain to be served. The vent rough-in shall connect to the vent system, or shall be vented by other means as provided for in this Chapter. The vent rough-in shall connect to the vent system. The connection shall be identified to indicate that the connection is a vent.

SECTION 906 FIXTURE VENTS

906.1 Distance of trap from vent. Each fixture trap shall have a protecting vent located so that the slope and the developed length in the fixture drain from the trap weir to the vent fitting are within the requirements set forth in Table 906.1.

906.2 Venting of fixture drains. The vent for a fixture drain, except where serving a fixture with integral traps, such as water closets, shall connect above the weir of the fixture trap being vented.

906.3 Crown vent. A vent shall not be installed within two pipe diameters of the trap weir.

SECTION 907 INDIVIDUAL VENT

907.1 Individual vent permitted. Each trap and trapped fixture is permitted to be provided with an individual vent. The individual vent shall connect to the fixture drain of the trap or trapped fixture being vented.

907.2 Water closets. All fixtures discharging downstream from a water closet shall be individually vented, except as provided in Section 911.

SECTION 908 COMMON VENT

908.1 Individual vent as common vent. An individual vent is permitted to vent two traps or trapped fixtures as a common vent. The traps or trapped fixtures being common vented shall be located on the same floor level.

908.2 Connection at the same level. Where the fixture drains being common vented connect at the same level, the vent connection shall be at the interconnection of the fixture drains or downstream of the interconnection.

908.3 Connection at different levels. Where the fixture drains connect at different levels, the vent shall connect as a vertical extension of the vertical drain. The vertical drain pipe connecting the two fixture drains shall be considered the vent for the lower fixture drain, and shall be sized in accordance with Table 908.3. The upper fixture shall not be a water closet.

TABLE 906.1
MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT

SIZE OF TRAP (inches)	SIZE OF FIXTURE DRAIN (inches)	SLOPE (inch per foot)	DISTANCE FROM TRAP (feet)
1 $\frac{1}{4}$	1 $\frac{1}{4}$	$\frac{1}{4}$	3 $\frac{1}{2}$
1 $\frac{1}{4}$	1 $\frac{1}{2}$	$\frac{1}{4}$	5
1 $\frac{1}{2}$	1 $\frac{1}{2}$	$\frac{1}{4}$	5
1 $\frac{1}{2}$	2	$\frac{1}{4}$	6
2	2	$\frac{1}{4}$	6
3	3	$\frac{1}{8}$	10
4	4	$\frac{1}{8}$	12

**TABLE 908.3
COMMON VENT SIZES**

PIPE SIZE (inches)	MAXIMUM DISCHARGE FROM UPPER FIXTURE DRAIN (drainage fixture unit)
1½	1
2	4
2½ to 3	6

SECTION 909 WET VENTING

909.1 Wet vent permitted. Any combination of fixtures within two bathroom groups located on the same floor level are permitted to be vented by a wet vent. The wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent along the direction of the flow in the drain pipe to the most downstream fixture drain connection to the horizontal branch drain. Only the fixtures within the bathroom groups shall connect to the wet-vented horizontal branch drain. Any additional fixtures shall discharge downstream of the wet vent.

909.2 Vent connection. The dry vent connection to the wet vent shall be an individual vent or common vent to the lavatory, bidet, shower or bathtub. The dry vent shall be sized based on the largest diameter of pipe within the wet vent system served by the dry vent.

909.3 Size. The wet vent shall be of a minimum size as specified in Table 909.3, based on the fixture unit discharge to the wet vent.

**TABLE 909.3
WET VENT SIZE**

WET VENT PIPE SIZE (inches)	DRAINAGE FIXTURE UNIT LOAD
1½	1
2	4
2½	6
3	12

SECTION 910 WASTE STACK VENT

910.1 Waste stack vent permitted. A waste stack shall be considered a vent for all of the fixtures discharging to the stack where installed in accordance with the requirements of this Section.

910.2 Stack installation. The waste stack shall be vertical, and both horizontal and vertical offsets shall be prohibited. Every fixture drain shall connect separately to the waste stack. The stack shall not receive the discharge of water closets or urinals.

910.3 Stack vent. A stack vent shall be provided for the waste stack. The size of the stack vent shall be equal to the size of the waste stack. Offsets shall be permitted in the stack vent and shall be located at least 6 inches above the flood level of the highest fixture, and shall be in accordance with Subsection 905.2.

910.4 Waste stack size. The waste stack shall be sized based on the total discharge to the stack and the discharge within a branch interval in accordance with Table 910.4. The waste stack shall be the same size throughout the length of the waste stack.

**TABLE 910.4
WASTE STACK VENT SIZE**

STACK SIZE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS	
	Total discharge into one branch interval	Total discharge for stack
1½	1	2
2	2	4
2½	No limit	8
3	No limit	24
4	No limit	50
5	No limit	75
6	No limit	100

SECTION 911 CIRCUIT VENTING

911.1 Circuit vent permitted. A maximum of eight fixtures connected to a horizontal branch drain shall be permitted to be circuit vented. Each fixture drain shall connect horizontally to the horizontal branch being circuit vented. The horizontal branch drain shall be classified as a vent from the most downstream fixture drain connection to the most upstream fixture drain connection to the horizontal branch.

911.1.1 Multiple circuit-vented branches. Circuit-vented horizontal branch drains are permitted to be connected together. Each group of a maximum of eight fixtures shall be considered a separate circuit vent and shall conform to the requirements of this Section.

911.2 Vent connection. The circuit vent connection shall be located between the two most upstream fixture drains. The vent shall connect to the horizontal branch and shall be installed in accordance with Section 905. The circuit vent pipe shall not receive the discharge of any soil or waste.

911.3 Slope and size of horizontal branch. The maximum slope of the vent section of the horizontal branch drain shall be one unit vertical in 12 units horizontal (8-percent slope). The entire length of the vent section of the horizontal branch drain shall be sized for the total drainage discharge to the branch.

911.3.1 Size of multiple circuit vent. Each separate circuit-vented horizontal branch that is interconnected shall be sized independently in accordance with Subsection 911.3. The downstream circuit-vented horizontal branch shall be sized for the total discharge into the branch, including the upstream branches and the fixtures within the branch.

911.4 Relief vent. A relief vent shall be provided for circuit-vented horizontal branches receiving the discharge of four or more water closets and connecting to a drainage stack that

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receives the discharge of soil or waste from upper horizontal branches.

911.4.1 Connection and installation. The relief vent shall connect to the horizontal branch drain between the stack and the most downstream fixture drain of the circuit vent. The relief vent shall be installed in accordance with Section 905.

911.4.2 Fixture drain or branch. The relief vent is permitted to be a fixture drain or fixture branch for fixtures located within the same branch interval as the circuit-vented horizontal branch. The maximum discharge to a relief vent shall be four fixture units.

911.5 Additional fixtures. Fixtures, other than the circuit-vented fixtures, are permitted to discharge to the horizontal branch drain. Such fixtures shall be located on the same floor as the circuit-vented fixtures and shall be either individually or common vented.

SECTION 912

COMBINATION WASTE AND VENT SYSTEM

912.1 Type of fixtures. A combination waste and vent system shall not serve fixtures other than floor drains, sinks, lavatories and drinking fountains. Combination drain and vent systems shall not receive the discharge of a food waste grinder or clinical sink.

912.2 Installation. The only vertical pipe of a combination waste and vent system shall be the connection between the fixture drain and the horizontal combination waste and vent pipe. The maximum vertical distance shall be 8 feet. The vertical distance shall not exceed 8 feet.

912.2.1 Slope. The slope of a horizontal combination waste and vent pipe shall not exceed one-half unit vertical in 12 units horizontal (4-percent slope) and shall not be less than that indicated in Table 704.1.

912.2.2 Connection. The combination waste and vent system shall be provided with a dry vent connected at any point within the system or the system shall connect to a horizontal drain that is vented in accordance with one of the venting methods specified in this Chapter. Combination waste and vent systems connecting to building drains receiving only the discharge from a stack or stacks shall be provided with a dry vent. The vent connecting to the combination waste and vent pipe shall extend vertically not less than 6 inches above the flood level rim of the highest fixture being vented before offsetting horizontally.

912.2.3 Vent size. The vent shall be sized for the total drainage fixture unit load in accordance with Subsection 916.2.

912.2.4 Fixture branch or drain. The fixture branch or fixture waste shall connect to the combination drain and vent within a distance specified in Table 906.1. The combination drain and vent pipe shall be considered the vent for the fixture.

912.3 Size. The minimum size of a combination waste and vent pipe shall be in accordance with Table 912.3. The hori-

zontal length of a combination waste and vent system shall be unlimited.

TABLE 912.3
SIZE OF COMBINATION DRAIN AND VENT PIPE

DIAMETER PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS	
	CONNECTING TO A HORIZONTAL BRANCH OR STACK	CONNECTING TO A BUILDING DRAIN OR BUILDING SUBDRAIN
2	3	4
2½	6	26
3	12	31
4	20	50
5	160	250
6	360	575

SECTION 913

ISLAND FIXTURE VENTING

913.1 Limitation. Island fixture venting shall not be permitted for fixtures other than sinks and lavatories. Residential kitchen sinks with a dishwasher waste connection, a food waste grinder or both, in combination with the kitchen sink waste, shall be permitted to be vented in accordance with this Section.

913.2 Vent connection. The island fixture vent shall connect to the fixture drain as required for an individual or common vent. The vent shall rise vertically to above the drainage outlet of the fixture being vented before offsetting horizontally or vertically downward. The vent or branch vent for multiple island fixture vents shall extend to a minimum of 6 inches above the highest island fixture being vented before connecting to the outside vent terminal.

913.3 Vent installation below the fixture flood level rim. The vent located below the flood level rim of the fixture being vented shall be installed as required for drainage piping in accordance with Chapter 7, except for sizing. The vent shall be sized in accordance with Subsection 916.2. The lowest point of the island fixture vent shall connect full size to the drainage system. The connection shall be to a vertical drain pipe or to the top half of a horizontal drain pipe. Cleanouts shall be provided in the island fixture vent to permit rodding of all vent piping located below the flood level rim of the fixtures. Rodding in both directions shall be permitted through a cleanout.

SECTION 914

RELIEF VENTS—STACKS OF MORE THAN 10 BRANCH INTERVALS

914.1 Where required. Soil and waste stacks in buildings having more than 10 branch intervals shall be provided with a relief vent at each 10th interval installed, beginning with the top floor.

914.2 Size and connection. The size of the relief vent shall be equal to the size of the vent stack to which it connects. The lower end of each relief vent shall connect to the soil or waste stack through a wye below the horizontal branch serving the floor, and the upper end shall connect to the vent stack through a wye not less than 3 feet above the floor.

SECTION 915 VENTS FOR STACK OFFSETS

915.1 Vent for horizontal offset of drainage stack. Horizontal offsets of drainage stacks shall be vented where five or more branch intervals are located above the offset. The offset shall be vented by venting the upper section of the drainage stack and the lower section of the drainage stack.

915.2 Upper section. The upper section of the drainage stack shall be vented as a separate stack with a vent stack connection installed in accordance with Subsection 903.4. The offset shall be considered the base of the stack.

915.3 Lower section. The lower section of the drainage stack shall be vented by a yoke vent connecting between the offset and the next lower horizontal branch. The yoke vent connection shall be permitted to be a vertical extension of the drainage stack. The size of the yoke vent and connection shall be a minimum of the size required for the vent stack of the drainage stack.

SECTION 916 VENT PIPE SIZING

916.1 Size of stack vents and vent stacks. The minimum required diameter of stack vents and vent stacks shall be determined from the developed length and the total of drainage fixture units connected thereto in accordance with Table 916.1, but in no case shall the diameter be less than one-half the diameter of the drain served or less than 1 $\frac{1}{4}$ inches.

916.2 Other vents. The diameter of individual vents, branch vents, circuit vents and relief vents shall be at least one-half the required diameter of the drain served. The required size of the drain shall be determined in accordance with Chapter 7. Vent pipes shall not be less than 1 $\frac{1}{4}$ inches in diameter. Vents exceeding 40 feet in developed length shall be increased by one nominal pipe size for the entire developed length of the vent pipe. Relief vents for soil and waste stacks in buildings having more than 10 branch intervals shall be sized in accordance with Subsection 914.2.

916.3 Developed length. The developed length of individual, branch, circuit and relief vents shall be measured from the farthest point of the vent connection to the drainage system to the point of connection to the vent stack, stack vent or termination outside of the building.

916.4 Multiple branch vents. Where multiple branch vents are connected to a common branch vent, the common branch vent shall be sized in accordance with this Section based on the size of the common horizontal drainage branch that is, or would be, required to serve the total drainage fixture unit load being vented.

916.4.1 Multiple branch vents exceeding 40 feet in developed length. Multiple branch vents exceeding 40 feet in developed length shall be increased by one nominal size for the entire developed length of the vent pipe.

916.5 Sump vents. Sump vent sizes shall be determined in accordance with Subsections 916.5.1 and 916.5.2.

916.5.1 Sewage pumps and sewage ejectors other than pneumatic. Drainage piping below sewer level shall be

vented in a similar manner to that of a gravity system. Building sump vent sizes for sumps with sewage pumps or sewage ejectors, other than pneumatic, shall be determined in accordance with Table 916.5.1.

916.5.2 Pneumatic sewage ejectors. The air pressure relief pipe from a pneumatic sewage ejector shall be connected to an independent vent stack terminating as required for vent extensions through the roof. The relief pipe shall be sized to relieve air pressure inside the ejector to atmospheric pressure, but shall not be less than 1 $\frac{1}{4}$ inches in size.

SECTION 917 AIR ADMITTANCE VALVES

917.1 General. Vent systems utilizing air admittance valves shall comply with this Section. Stack-type air admittance valves shall conform to ASSE 1050. Individual- and branch-type air admittance valves shall conform to ASSE 1051.

917.2 Installation. The valves shall be installed in accordance with the requirements of this Section and the manufacturer's installation instructions. Air admittance valves shall be installed after the DWV testing required by Subsection 312.2 or 312.3 has been performed.

917.3 Where permitted. Individual, branch and circuit vents shall be permitted to terminate with a connection to an individual or branch-type air admittance valve in accordance with Subsection 917.3.1. Stack vents and vent stacks shall be permitted to terminate to stack-type air admittance valves in accordance with Subsection 917.3.2.

917.3.1 Horizontal branches. Individual and branch-type air admittance valves shall vent only fixtures that are on the same floor level and connect to a horizontal branch drain. Where the horizontal branch is located more than four branch intervals from the top of the stack, the horizontal branch shall be provided with a relief vent that shall connect to a vent stack or stack vent, or extend outdoors to the open air. The relief vent shall connect to the horizontal branch drain between the stack and the most downstream fixture drain connected to the horizontal branch drain. The relief vent shall be sized in accordance with Subsection 916.2 and installed in accordance with Section 905. The relief vent shall be permitted to serve as the vent for other fixtures.

917.3.2 Stack. Stack-type air admittance valves shall be prohibited from serving as the vent terminal for vent stacks or stack vents that serve drainage stacks having more than six branch intervals.

917.4 Location. Individual and branch-type air admittance valves shall be located a minimum of 4 inches above the horizontal branch drain or fixture drain being vented. Stack-type air admittance valves shall be located not less than 6 inches above the flood level rim of the highest fixture being vented. The air admittance valve shall be located within the maximum developed length permitted for the vent. The air admittance valve shall be installed a minimum of 6 inches above insulation materials.

VENTS

TABLE 916.1
SIZE AND DEVELOPED LENGTH OF STACK VENTS AND VENT STACKS

DIAMETER OF SOIL OR WASTE STACK (inches)	TOTAL DRAINAGE FIXTURE UNITS BEING VENTED	MAXIMUM DEVELOPED LENGTH OF VENT (feet) ^a DIAMETER OF VENT (inches)										
		1 ¹ / ₄	1 ¹ / ₂	2	2 ¹ / ₂	3	4	5	6	8	10	12
1 ¹ / ₄	2	30										
1 ¹ / ₂	8	50	150									
1 ¹ / ₂	10	30	100									
2	12	30	75	200								
2	20	26	50	150								
2 ¹ / ₂	42		30	100	300							
3	10		42	150	360	1,040						
3	21		32	110	270	810						
3	53		27	94	230	680						
3	102		25	86	210	620						
4	43			35	85	250	980					
4	140			27	65	200	750					
4	320			23	55	170	640					
4	540			21	50	150	580					
5	190				28	82	320	990				
5	490				21	63	250	760				
5	940				18	53	210	670				
5	1,400				16	49	190	590				
6	500					33	130	400	1,000			
6	1,100					26	100	310	780			
6	2,000					22	84	260	660			
6	2,900					20	77	240	600			
8	1,800						31	94	240	940		
8	3,400						24	73	190	720		
8	5,600						20	62	160	610		
8	7,600						18	56	140	560		
10	4,000							31	78	310	960	
10	7,200							24	60	240	740	
10	11,000							20	51	200	630	
10	15,000							18	46	180	570	
12	7,300								31	120	380	940
12	13,000								24	94	300	720
12	20,000								20	79	250	610
12	26,000								18	72	230	500
15	15,000									40	130	310
15	25,000									31	96	240
15	38,000									26	81	200
15	50,000									24	74	180

a. The developed length shall be measured from the vent connection to the open air.

**TABLE 916.5.1
SIZE AND LENGTH OF SUMP VENTS**

DISCHARGE CAPACITY OF PUMP (gpm)	MAXIMUM DEVELOPED LENGTH OF VENT (feet) ^a					
	Diameter of vent (inches)					
	1 ¹ / ₄	1 ¹ / ₂	2	2 ¹ / ₂	3	4
10	No limit ^b	No limit	No limit	No limit	No limit	No limit
20	270	No limit	No limit	No limit	No limit	No limit
40	72	160	No limit	No limit	No limit	No limit
60	31	75	270	No limit	No limit	No limit
80	16	41	150	380	No limit	No limit
100	10 ^c	25	97	250	No limit	No limit
150	Not permitted	10 ^c	44	110	370	No limit
200	Not permitted	Not permitted	20	60	210	No limit
250	Not permitted	Not permitted	10	36	132	No limit
300	Not permitted	Not permitted	10 ^c	22	88	380
400	Not permitted	Not permitted	Not permitted	10 ^c	44	210
500	Not permitted	Not permitted	Not permitted	Not permitted	24	130

a. Developed length plus an appropriate allowance for entrance losses and friction due to fittings, changes in direction and diameter. Suggested allowances shall be obtained from NBS Monograph 31 or other approved sources. An allowance of 50 percent of the developed length shall be assumed if a more precise value is not available.

b. Actual values greater than 500 feet.

c. Less than 10 feet.

917.5 Access and ventilation. Access shall be provided to all air admittance valves. The valve shall be located within a ventilated space that allows air to enter the valve.

917.6 Size. The air admittance valve shall be rated for the size of the vent to which the valve is connected.

917.7 Vent required. Within each plumbing system, a minimum of one stack vent or vent stack shall extend outdoors to the open air.

917.8 Prohibited installations. Air admittance valves shall not be installed in nonneutralized special waste systems as described in Chapter 8 except where such valves are in compliance with ASSE 1049, constructed of materials approved in accordance with Section 702.5 and tested for chemical resistance in accordance with ASTM F1412. Valves shall not be located in spaces utilized as supply or return air plenums. Air admittance valves without an engineered design shall not be utilized to vent sumps or tanks of any type.

SECTION 918 ENGINEERED VENT SYSTEMS

918.1 General. Engineered vent systems shall comply with this Section, and the design submittal, approval, inspection and testing requirements of Section 312.

918.2 Individual branch fixture and individual fixture header vents. The maximum developed length of individual fixture vents to vent branches and vent headers shall be determined in accordance with Table 918.2 for the minimum pipe diameters at the indicated vent airflow rates.

The individual vent airflow rate shall be determined in accordance with the following:

$$Q_{h,b} = N_{n,b} Q_v$$

Where:

$N_{n,b}$ = Number of fixtures per header (or vent branch), total number of fixtures connected to vent stack.

$Q_{h,b}$ = Vent branch or vent header airflow rate [cubic feet per minute (cfm)].

Q_v = Total vent stack airflow rate (cfm).

$$Q_v (\text{gpm}) = 27.8 r_s^{2/3} (1 - r_s) D^{8/3}$$

$$Q_v (\text{cfm}) = 0.134 Q_v (\text{gpm})$$

Where:

D = Drainage stack diameter (inches).

Q_w = Design discharge load (gpm).

r_s = Waste water flow area to total area.

$$= \frac{Q_w}{27.8 D^{8/3}}$$

Individual vent airflow rates are obtained by equally distributing $Q_{h,b}$ into one-half the total number of fixtures on the branch or header for more than two fixtures; for an odd number of total fixtures, decrease by one; for one fixture, apply the full value of $Q_{h,b}$.

Individual vent developed length shall be increased by 20 percent of the distance from the vent stack to the fixture vent connection on the vent branch or header.

SECTION 919 COMPUTERIZED VENT DESIGN

919.1 Design of vent systems. The sizing, design and layout of the vent system shall be permitted to be determined by approved computer program design methods.

919.2 System capacity. The vent system shall be based on the air-capacity requirements of the drainage system under a peak load condition.

**TABLE 918.2
MINIMUM DIAMETER AND MAXIMUM LENGTH OF INDIVIDUAL BRANCH FIXTURE
VENTS AND INDIVIDUAL FIXTURE HEADER VENTS FOR SMOOTH PIPES**

DIAMETER OF VENT PIPE (inches)	INDIVIDUAL VENT AIRFLOW RATE (cfm)																			
	MAXIMUM DEVELOPED LENGTH OF VENT (feet)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1/2	95	25	13	8	5	4	3	2	1	1	1	1	1	1	1	1	1	1	1	1
3/4	100	88	47	30	20	15	10	9	7	6	5	4	3	3	3	2	2	2	2	1
1	—	—	100	94	65	48	37	29	24	20	17	14	12	11	9	8	7	7	6	6
1 1/4	—	—	—	—	—	—	—	100	87	73	62	53	46	40	36	32	29	26	23	21
1 1/2	—	—	—	—	—	—	—	—	—	—	—	100	96	84	75	67	60	54	49	45
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	100

CHAPTER 10

TRAPS, INTERCEPTORS AND SEPARATORS

SECTION 1001 GENERAL

1001.1 Scope. This Chapter shall govern the material and installation of traps, interceptors and separators.

SECTION 1002 TRAP REQUIREMENTS

1002.1 Fixture traps. Each plumbing fixture shall be separately trapped by a water-seal trap, except as otherwise permitted by this Code. The trap shall be placed as close as possible to the fixture outlet. The vertical distance from the fixture outlet to the trap weir shall not exceed 24 inches. The distance of a clothes washer standpipe above a trap shall conform to Subsection 802.4. A fixture shall not be double trapped.

Exceptions:

1. This Section shall not apply to fixtures with integral traps.
2. A combination plumbing fixture is permitted to be installed on one trap, provided that one compartment is not more than 6 inches deeper than the other compartment and the waste outlets are not more than 30 inches apart.
3. A grease trap, intended to serve as a fixture trap in accordance with the manufacturer's installation instructions, shall be permitted to serve as the trap for a single fixture or a combination sink of not more than three compartments where the vertical distance from the fixture outlet to the inlet of the interceptor does not exceed 30 inches, and the developed length of the waste pipe from the most upstream fixture outlet to the inlet of the interceptor does not exceed 60 inches.

1002.2 Design of traps. Fixture traps shall be self-scouring. Fixture traps shall not have interior partitions, except where such traps are integral with the fixture or where such traps are constructed of an approved material that is resistant to corrosion and degradation. Slip joints shall be made with an approved elastomeric gasket and shall only be installed on the trap inlet, trap outlet and within the trap seal.

1002.3 Prohibited traps. The following types of traps are prohibited:

- (a) Traps that depend on moving parts to maintain the seal.
- (b) Bell traps.
- (c) Crown-vented traps.
- (d) Separate fixture traps that depend on interior partitions for the seal, except those traps constructed of an approved material that is resistant to corrosion and degradation.
- (e) "S" traps.

- (f) Drum traps, except where approved.

Exception: Drum traps used as solids interceptors and drum traps serving chemical waste systems shall not be prohibited.

1002.4 Trap seals. Each fixture trap shall have a liquid seal of not less than 2 inches and not more than 4 inches or deeper for special designs relating to accessible fixtures. Floor drain trap seals subject to evaporation shall be connected to the fixture waste outlet to maintain the water seal. Where no waste outlet is available, the trap primer may be connected to the cold water supply through an approved device that conforms to ASSE 1018 or ASSE 1044.

Exception: Floor drains located in areas that receive regular wash downs (such as kitchens, restrooms, bathrooms) may be made exempt as determined by the Chief Plumbing Inspector.

1002.5 Size of fixture traps. Fixture trap size shall be sufficient to drain the fixture rapidly and not less than the size indicated in Table 709.1. A trap shall not be larger than the drainage pipe into which the trap discharges.

1002.6 Building traps. Building (house) traps shall be prohibited, except where local conditions necessitate such traps. Building traps shall be provided with a cleanout and a relief vent, or fresh air intake on the inlet side of the trap. The size of the relief vent or fresh air intake shall not be less than one-half the diameter of the drain to which the relief vent or air intake connects. Such relief vent or fresh air intake shall be carried above grade and shall be terminated in a screened outlet located outside the building.

1002.7 Trap setting and protection. Traps shall be set level with respect to the trap seal and, where necessary, shall be protected from freezing.

1002.8 Recess for trap connection. A recess provided for the connection of the underground trap, such as one serving a bathtub in slab-type construction, shall have sides and a bottom of corrosion-resistant, insectproof and verminproof construction.

1002.9 Acid-resisting traps. Where a vitrified clay or other brittleware, acid-resisting trap is installed underground, such trap shall be embedded in concrete extending 6 inches beyond the bottom and sides of the trap.

1002.10 Plumbing in mental health centers. In mental health centers, pipes and traps shall not be exposed.

SECTION 1003 INTERCEPTORS AND SEPARATORS

1003.1 Where required. Interceptors and separators shall be provided to prevent the discharge of oil, grease, sand and other substances harmful or hazardous to the building drainage system, the public sewer, or sewage treatment plant or processes.

1003.2 Approval. The size, type and location of each interceptor and of each separator shall be designed and installed in accordance with the manufacturer's installation instructions and the requirements of this Section based on the anticipated conditions of use. Wastes that do not require treatment or separation shall not be discharged into any interceptor or separator.

1003.3 Grease traps and grease interceptors. Grease traps and grease interceptors shall comply with the requirements of Subsections 1003.3.1 through 1003.3.4.2 and Table 1003.3.1.

1003.3.1 Grease traps and grease interceptors required. A grease trap or grease interceptor shall be required to receive the drainage from fixtures and equipment with grease-laden waste located in food-preparation areas, such as in restaurants, hotel kitchens, hospitals, school kitchens, bars, factory cafeterias, or restaurants and clubs.

1003.3.2 Food waste grinders. Where food waste grinders connect to grease traps or grease interceptors, the grease interceptor shall be sized and rated for the food waste grinder.

1003.3.3 Grease trap and grease interceptor not required. A grease trap or grease interceptor shall not be required for individual dwelling units or any private living quarters.

1003.3.4 Grease interceptor design criteria.

1003.3.4.1 General.

Minimum size 750 gallons
Maximum size of single trap 5,000 gallons

1003.3.4.2 Definitions of food service types:

DELI STYLE. Food that does not use cooking oil in the preparation or service, and that has an option for carry out orders. Deli style facilities will have no fryers, and be principally cold service foods.

FAST FOOD. Food that uses cooking oils of any type in the preparation or service, and that has an option for carry out orders. Fast food facilities will use a fryer of some type and size for food preparation.

FULL SERVICE. A sit-down facility includes all facilities that serve food in a dining area, utilize washable cutlery, plates and glassware and serve any type of alcoholic beverage.

STANDARD SERVICE. A sit-down facility that includes all facilities that serve food in a dining area and utilize washable cutlery and washable plates and glassware, but do not serve alcoholic beverages.

1003.3.4.3 Procedure for determining grease interceptor size:

1. Determine the peak flow to the interceptor.
 - (a) Determine the number of seats (maximum) and assume 100-percent use/occupancy.
 - (b) Determine the maximum number of take-out meals served (if any).

- (c) Apply the flow factors to the above.
 - (i) 25 gallons per day (gpd) per seat
 - (ii) 5 gallons per take out meal (nonfast food)
 - (iii) 2.5 gallons per take out meal (fast food)

- (d) Apply the peak factor.
 - (i) Use 3.0 times unless documented otherwise

Peak Flow (gpd) = (# Seats × 25 + # take-out meals × (5 or 2.5) × peak factor of 3.

2. Determine the type and character of the Facility and interceptor cleaning frequency.

- (a) Apply the appropriate service factors for:

- (i) Operating hours
- (ii) Food service type
- (iii) Proposed cleaning frequency
- (iv) Seat turnover

3. Complete the calculation for the interceptor size:

Trap Volume = Peak flow (in gpm) ÷ 1440 (minutes per day) × 120 minutes Detention Time × Cleaning Factor × Open Hours Factor × Service Type Factor × Seat Factor.

4. Select the appropriate interceptor size by rounding up to the nearest 100 gallon increment.

5. For trap volumes exceeding 5,000 gallons, use multiple units operating in parallel.

**TABLE 1003.3.1
OPERATIONAL AND FACILITY FACTORS
FOR SIZING INTERCEPTORS**

TRAP SIZE BASED ON	MULTIPLIER
1) Cleaning frequency of interceptor: a) Standard frequency = 1/quarter b) Minimum frequency = 1/year c) Maximum frequency = 1/month d) Minimal frequency = 2 × 1 yr	1 4 0.33 2
2) Hours of operation of food/kitchen service ^a : a) Standard operation = 12 hours/day b) Minimum operation = 8 hours/day c) Maximum operation = 20 hours/day d) Extended operation = 16 hours/day	1 0.6667 1.667 1.333
3) Number of meals served per day (max. day) and	None
4) Number of seats in restaurant: a) Standard turnover ratio: 1/hour b) Maximum turnover ratio: 2/hour c) Minimum turnover ratio: 1/2/hour	1 2 0.5
5) Type of food service: a) Fast food with or without take-out b) Deli style with or without sit-down facilities c) Sit-down, standard service d) Sit-down, full service	1.2 0.8 1 1.5

a. For operating hours other than those listed, use a ratio of: actual hours/12.

Size of interceptor is a function of:

1. Detention time desired in trap, usually this is a minimum of 2 hours.
2. Type of drains routed through trap—sanitary drains should be piped separately.
3. Water volume or flow rate generated from the number of seats and/or meals served.

Basis and rational for formula:

- 5 gallons per meal is used as the water volume if meals served is the design basis.
- 15 – 50 gallons per seat shall be used as the water volume if seats used are the design basis.
- A minimum of two hours of detention time (DT) in the interceptor is required at peak flow rates greater than 120 minutes.
- If the facility is a combination sit-down and take-out, then a combination of these shall be used for flow estimation.
- The number of meals served at the sit-down is allowed to be subtracted from the total meals served to calculate flow; or
- The number of seats plus the maximum number of meals taken out shall be used for flow calculations.

Basic formula shall be:

Trap Volume = Peak Flow (in gpm) ÷ 1440 (minutes per day) × 120 minutes Detention Time × Cleaning Factor × Open Hours Factor × Service Type Factor × Seat Factor.

- Flow shall be based on the number of seats or meals served or a combination of both times a flow factor for each. Twenty-five gallons per seat is the norm for this criterion, and 5 gallons per meal.
- However, for fast food and deli service operations, which use primarily paper and plastic cutlery and packaging, a figure of 2.5 gallons per meal served shall be used for fast food and deli food style establishments.
- If the design criterion value used is the number of seats, then a factor for the turnover ratio of the seats shall be used.

Standard and full service sit-down	Peak Flow = (Number of seats × 25 gpd/seat + number of take-out meals (max.) × 5 gal/meal) × Peak Factor. Peak Factor to be 3 times unless justification can be provided to the Building Official substantiating a lesser value.
Deli/fast food	Peak Flow = (Number of seats × 25 gpd/seat + number of take-out meals (max.) × 2.5 gal/meal) × Peak Factor Peak Factor to be 3 times unless justification can be provided to the Building Official substantiating a lesser value.

Examples of formula applications:

Example 1: Assume a sit-down restaurant that is open 12 hours per day, has 120 seats, has 1-hour per seat turnover and intends to clean their trap quarterly. Also assume they use 25 gallons per seat and a peaking factor of 3. All operational and facility factors would therefore be 1.0.

Trap size would be:

Flow = $120 \times 25 \times 3 = 9,000$ gallons per day.

Trap Size = $9,000/1,440 \times 120 = 750$ gallons, or the minimum size.

Example 2: Assume that we have a fast food restaurant that serves 5,000 meals a day, is open 16 hours a day, has seating capacity for 40 people, turns the seats over 1/hour, and intends to clean the trap on a quarterly basis.

Trap size would be:

Flow = $40 \times 25 \times 3 = 3,000$ gallons per day

Number of meals served at sit-down = $40 \times 16 \times 1/\text{hr} = 640$
plus $(5,000 - 640) \times 2.5 = 10,900$ gallons

Total flow = 13,900 gallons

Trap size = $13,900/1,440 \times 120 \times 1.333 = 1,540$ gallons
or about twice the size of the smallest trap.

Example 3: Let's examine an extreme case, a fast food restaurant serving 15,000 meals a day, having 200 seats, open 20 hours per day, turning over their seats every 30 minutes and intending to clean their trap quarterly.

Trap size would be:

Flow = $200 \times 25 \times 3 = 15,000$ gpd

Number of meals served at sit-down = $200 \times 16 \times 2 = 6,400$
plus $15,000 - 6,400 \times 2.5 = 21,500$ gallons

Trap size = $(15,000 + 21,500)/1,440 \times 120 \times 1.667 = 5,079$ gallons

If this facility only intended to clean their trap 2 times per year, the size would double to 10,000 gallons.

Example 4: Here is another extreme case. A walk-up deli style open 8 hours per day with no seats and expecting to service its trap only annually, serving 500 meals per day on a peak day, or about one per minute.

Trap size would be:

Flow = $500 \times 2.5 \times 3 = 3,750$ gpd, based on meals served only, no sit-down.

Trap size: $3,750/1,440 \times 120 \times 0.667 \times 0.5 \times 4 = 417$ gallons;
or a minimum tank of 750 gallons would suffice.

Example 5: Assume a large full service restaurant with 500 seats, open 16 hours per day, with turnover of seats at once per hour with no take-out, and cleaned quarterly.

Trap size would be:

Flow = $500 \times 25 \times 3 = 37,500$ gallons

Trap size = $37,500/1,440 \times 120 \times 1.33 \times 1.2 \times 1.0 = 4987.5$ gallons or say 5,000 gallons

1003.4 Oil separators required. At repair garages; gasoline stations with grease racks, grease pits or work racks; and factories where oily and flammable liquid wastes are produced, separators shall be installed into which all oil-bearing, grease-bearing or flammable wastes shall be discharged before emptying in the building drainage system or other point of disposal.

1003.4.1 Separation of liquids. A mixture of treated or untreated light and heavy liquids with various specific gravities shall be separated in an approved receptacle.

TRAPS, INTERCEPTORS AND SEPARATORS

1003.4.2 Oil separator design. Oil separators shall be designed in accordance with Subsections 1003.4.2.1 and 1003.4.2.2.

1003.4.2.1 General design requirements. Oil separators shall have a depth of not less than 2 feet below the invert of the discharge drain. The outlet opening of the separator shall not have less than an 18-inch water seal.

1003.4.2.2 Garages and service stations. Where automobiles are serviced, greased, repaired or washed, or where gasoline is dispensed, separators shall have a minimum capacity of 6 cubic feet for the first 100 square feet of area to be drained, plus 1 cubic foot for each additional 100 square feet of area to be drained into the separator. Parking garages, in which servicing, repairing or washing is not conducted, and in which gasoline is not dispensed, shall not require a separator. Areas of commercial garages utilized only for the storage of automobiles are not required to be drained through a separator.

1003.5 Sand interceptors in commercial establishments. Sand and similar interceptors for heavy solids shall be designed and located so as to be provided with ready access for cleaning, and shall have a water seal of not less than 6 inches.

1003.6 Laundries. Commercial laundries shall be equipped with an interceptor with a wire basket or similar device, removable for cleaning, that prevents the passage into the drainage system of solids $\frac{1}{2}$ inch or larger in size, string, rags, buttons or other materials detrimental to the public sewerage system.

1003.7 Bottling establishments. Bottling plants shall discharge process wastes into an interceptor that will provide for the separation of broken glass or other solids before discharging waste into the drainage system.

1003.8 Slaughterhouses. Slaughtering room and dressing room drains shall be equipped with approved separators. The separator shall prevent the discharge into the drainage system of feathers, entrails and other materials that cause clogging.

1003.9 Venting of interceptors and separators. Interceptors and separators shall be designed so as not to become air bound where tight covers are utilized. Each interceptor or separator shall be vented where subject to a loss of trap seal.

1003.10 Access and maintenance of interceptors and separators. Access shall be provided to each interceptor and separator for service and maintenance. Interceptors and separators shall be maintained by the periodic removal of accumulated grease, scum, oil, or other floating substances and solids deposited in the interceptor or separator.

SECTION 1004 MATERIALS, JOINTS AND CONNECTIONS

1004.1 General. The materials and methods utilized for the construction and installation of traps, interceptors and separators shall comply with this Chapter, and the applicable provisions of Chapters 4 and 7. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing the flow of the piping.

CHAPTER 11

STORM DRAINAGE

SECTION 1101 GENERAL

1101.1 Scope. The provisions of this Chapter shall govern the materials, design, construction and installation of storm drainage.

1101.2 Drainage required. Roofs, paved areas, yards, courts and courtyards shall be drained into a storm sewer system or a combined sewer system where such systems are available.

1101.3 Prohibited drainage. Storm water shall not be drained into sewers intended for sewage only, unless approved by the Chief Plumbing Inspector.

1101.4 Expansion joints. Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

1101.5 Subsoil drains. Where subsoil drains are placed under a floor or are used to surround the outer walls of a building, they shall be made of open-jointed, or horizontally split or perforated, clay tile or plastic pipe meeting the requirements of Table 702.2, not less than a 4-inch diameter. When the building is subject to backwater, the subsoil drain shall be protected by an accessibly located backwater valve. Subsoil drains may discharge into a properly trapped area drain or sump. Such sumps do not require vents.

1101.6 Building subdrains. Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps.

1101.7 Pumping systems. Pumping systems installed to remove contents of collecting sumps shall include the sump pump, pit and discharge piping as defined in this Subsection.

- (a) **Sump pump.** An automatic water pump for the removal of drainage from a sump, pit or low point in a residential, commercial or industrial property shall be of a capacity and head appropriate to anticipated use requirements.
- (b) **Sump pit.** Size shall be not less than an 18-inch diameter and may be constructed of tile, steel, plastic, cast iron, concrete or other material accepted by the Chief Plumbing Inspector, topped by a removable cover adequate to support the anticipated loads in areas of use. The pump floor shall provide permanent support for the pump.
- (c) Electrical service outlets, when required, shall meet the requirements of the *EPCOT Electrical Code*.
- (d) Discharge piping shall meet the requirements of Subsection 1102.1, 1102.2, 1102.3 or 1102.4, and shall include a gate valve and a full-flow check valve. Size and fittings shall be the same size as, or larger than, pump discharge tapping.

1101.8 Backwater devices. The installation of backwater devices as protection for fixtures subject to backflow shall be in accordance with requirements of this Code.

1101.9 Tests. The interior leaders and downspouts system shall be tested in accordance with Section 312.

SECTION 1102 MATERIALS

1102.1 Inside conductors, including above-ground storm drains. Conductors placed within buildings, or run in vent or pipe shafts, shall be aluminum, cast-iron, galvanized or black steel, galvanized ferrous alloys, brass, lead, copper or Schedule 40 plastic pipe.

1102.2 Building storm drains connected to combined or sanitary sewers. All building storm drains connected to combined or sanitary sewers shall be of materials required for building drains in accordance with Subsections 702.3 and 702.4.

1102.3 Underground storm drains. Building storm drains shall be of cast-iron soil pipe, or ferrous-alloy piping, except that when approved by the Chief Plumbing Inspector, vitrified clay pipe, concrete pipe, copper tube Type DWV or plastic piping may be used.

1102.4 Building storm sewers. The building storm sewer shall be of cast-iron soil pipe, vitrified clay pipe, concrete pipe or plastic pipe meeting the requirements of Table 702.2.

SECTION 1103 SPECIFICATIONS

1103.1 General. Pipe, tubing and fittings for storm drainage systems shall conform to the standards listed in Table 702.4.

SECTION 1104 TRAPS

1104.1 Main trap. Individual storm water traps shall be installed on the storm water drain branch serving each conductor, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer, main drain or public sewer.

1104.2 Material. Storm water traps, when required, shall be as listed in Subsection 702.4.

1104.3 Exceptions. Traps shall not be required for storm water drains that are connected to a sewer carrying storm water exclusively.

1104.4 Size. Traps for individual conductors shall be the same size as the horizontal drain to which they are connected.

1104.5 Location. Conductor traps shall be so located that an accessible cleanout may be installed on the building side of the trap.

SECTION 1105 CONDUCTORS AND CONNECTIONS

1105.1 Prohibited use. Conductor pipes shall not be used as soil, waste or vent pipes, nor shall soil, waste or vent pipes be used as conductors.

1105.2 Protection. Rainwater conductors installed along alleyways, driveways or other locations where they may be exposed to damage shall be protected.

1105.3 Combining storm with sanitary drainage. The sanitary and storm drainage system of a building shall be entirely separate, except that where a combined sewer is permitted the building storm drain may be connected in the same horizontal plane to the combined drain or sewer at least 10 feet downstream from any soil stack.

1105.4 Floor drains. Floor drains shall not be connected to a storm drain.

SECTION 1106 ROOF DRAINS

1106.1 Material. Roof drains shall be of an approved corrosion-resistant material with adequate strainer area and shall comply with the applicable standards in ANSI/ASME A112.21.2M.

1106.2 Strainers. When roof drains are provided, they shall have strainers extending not less than 4 inches above the surface of the roof immediately adjacent to the roof drain. Strainers shall have an available inlet area, above roof level, of not less than $1\frac{1}{2}$ times the area of the conductor or leader to which the drain is connected.

1106.3 Flat decks. Roof drain strainers for use on sun decks, parking decks and similar areas, normally serviced and maintained, may be of the flat-surface type, level with the deck and shall have an available inlet area not less than two times the area of the conductor or leader to which the drain is connected.

1106.4 Roof drain flashing. The connection between roofs and roof drains that pass through the roof and into the interior of the building shall be made water tight by the use of proper flashing material.

SECTION 1107 SIZE OF LEADERS AND STORM DRAINS

1107.1 Vertical leaders. Shall be sized for the maximum projected roof area in accordance with Table 1107.1.

1107.2 Building storm drains. The size of the building storm drain or any of its horizontal branches having a slope of $\frac{1}{2}$ inch or less per foot shall be based upon the maximum projected roof area to be handled in accordance with Table 1107.2.

1107.2.1 Rainfall rate. Tables 1107.1 and 1107.2 are based upon a rate of rainfall of 8 inches per hour.

**TABLE 1107.1
SIZE OF VERTICAL LEADERS**

SIZE OF LEADER OR CONDUCTOR ^a (inches)	MAXIMUM PROJECTED ROOF AREA (square feet)
2	360
2½	650
3	1,100
4	2,300
5	4,325
6	6,750
8	14,500

a. The equivalent diameter of a square or rectangular leader may be taken as the diameter of that circle that may be inscribed within the cross-sectional area of the leader. See Subsection 1107.2.

**TABLE 1107.2
SIZE OF HORIZONTAL STORM DRAINS**

DIAMETER OF DRAIN (inches)	MAXIMUM PROJECTED ROOF AREA FOR DRAINS OF VARIOUS SLOPES (square feet)		
	1/8-INCH SLOPE	1/4-INCH SLOPE	1/2-INCH SLOPE
3	411	580	822
4	940	1,325	1,880
5	1,670	2,360	3,340
6	2,675	3,775	5,350
8	5,750	8,150	11,500
10	10,350	14,600	20,700
12	16,650	23,500	33,300
15	29,750	42,000	59,500

1107.3 Vertical walls. In sizing roof drains and storm drainage piping, one-half of the area of any vertical wall that diverts rainwater to the roof shall be added to the projected roof area for inclusion in calculating the required size of vertical leaders and horizontal storm drainage piping.

1107.4 Minimum rates of rainfall. Minimum rate of rainfall within the District shall be 8 inches per hour.

1107.5 Parapet wall scupper location. See the *EPCOT Building Code* for parapet wall roof drainage scupper and overflow scupper location requirements.

1107.5.1 Parapet wall scupper sizing. Parapet wall scupper shall be sized for the maximum projected roof area in accordance with Table 1107.3.

**TABLE 1107.3
SCUPPER SIZING TABLE ROOF AREA (square feet)**

HEAD (H) (inches)	LENGTH (L) OF WEIR (inches)						
	4	6	8	12	16	20	24
4	923	1,500	2,076	3,230	4,383	5,537	6,691
6	1,483	2,544	3,602	5,721	7,840	9,959	12,080
8	1,845	2,999	4,152	6,460	8,766	11,073	13,381

SECTION 1108 SECONDARY (EMERGENCY) ROOF DRAINS

1108.1 Secondary drainage required. Secondary (emergency) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water would be entrapped should the primary drains allow buildup for any reason.

1108.2 Separate systems required. Secondary roof drain systems shall have piping and point of discharge separate from the primary system. Discharge shall be above grade in a location that would normally be observed by the building occupants or maintenance personnel.

1108.3 Minimum rainfall rate for secondary drains. Minimum rainfall rate for secondary (emergency) roof drain systems or scuppers shall be in accordance with Subsection 1107.4.

SECTION 1109 VALUES FOR CONTINUOUS FLOW

1109.1 General. Where there is a continuous or semicontinuous discharge into the building storm drain or building storm sewer, such as from a pump, ejector, air-conditioning plant or similar device, each gallon per minute of such discharge shall be computed as being equivalent to 48 square feet of roof area.

SECTION 1110 BACKWATER VALVES

1110.1 Fixture branches. Backwater valves shall be installed in the branch of the building drain that receives only the discharge from fixtures located within such branch and shall be located below grade.

1110.2 Material. Backwater valves shall have all bearing parts of corrosion-resistant material. Backwater valves shall comply with ANSI/ASME A112.14.1, or CSA B181.1 or CSA B181.2.

1110.3 Seal. Backwater valves shall be so constructed as to ensure a mechanical seal against backflow.

1110.4 Diameter. Backwater valves, when fully opened, shall have a capacity not less than that of the pipes in which they are installed.

1110.5 Location. Backwater valves shall be so installed to be accessible for service and repair.

SECTION 1111 APPENDIX REFERENCES

1111.1 Appendices. Additional provisions for storm drainage are found in Appendix A. These provisions are hereby adopted as part of this Code.

SECTION 1112 SIPHONIC ROOF DRAINAGE SYSTEMS

1112.1 General. Siphonic roof drains and drainage systems shall be designed in accordance with ASME A112.6.9 and ASPE 45.

CHAPTER 12

FUEL PIPING

SECTION 1201 GENERAL

1201.1 Scope. The provisions of this Chapter shall govern the materials, design and installation of fuel piping.

SECTION 1202 NATURAL GAS PIPING

1202.1 Natural gas. All natural gas fuel piping shall be sized, installed, tested and placed in operation in accordance with the requirements of the *EPCOT Fuel Gas Code*.

SECTION 1203 LIQUEFIED PETROLEUM GAS (LP-GAS) PIPING

1203.1 LP-gas. All LP-gas fuel piping shall be sized, installed, tested and placed in operation in accordance with the requirements of the *EPCOT Fuel Gas Code* and the *EPCOT Building Code*.

SECTION 1204 LIQUID FUEL PIPING

1204.1 Liquid fuel. All other liquid fuel piping shall be sized, installed, tested and placed in operation in accordance with the requirements of the *EPCOT Mechanical Code*.

CHAPTER 13

SPECIAL PIPING AND STORAGE SYSTEMS

SECTION 1301 HOSPITAL SYSTEMS

1303.1 Scope. Provisions for hospital piping and storage systems are contained in Appendix H. These provisions are hereby made a part of this Code.

SECTION 1302 MEDICAL GASES

1302.1 Nonflammable medical gases. Nonflammable medical gas systems, inhalation anesthetic systems and vacuum piping systems shall be designed and installed in accordance with NFPA 99C.

Exceptions:

1. This Section shall not apply to portable systems or cylinder storage.
2. Vacuum system exhaust shall comply with the *EPCOT Mechanical Code*.

SECTION 1303 OXYGEN SYSTEMS

1303.1 Design and installation. Nonmedical oxygen systems shall be designed and installed in accordance with NFPA 50 and NFPA 51.

SECTION 1304 COMPRESSED AIR SYSTEMS

1304.1 Scope. The provisions of this Chapter shall govern the installation of compressed air systems.

1304.2 Approval. Third-party certified equipment shall be installed in accordance with its certification. Equipment that is not third-party certified shall be installed in accordance with the manufacturer's installation instructions, Subsections 1304.3 through 1304.5 and the Chief Plumbing Inspector.

1304.3 Equipment installation. All compressors shall derive their intake air from outside the building. Belt-driven equipment shall be suitably guarded when drive apparatus is less than 8 feet above the floor. All drains from compressors, dryers and similar equipment shall terminate indirectly to the sanitary sewer.

1304.4 Pressure relief for tanks. Every compressed air pressure tank shall be protected with a pressure relief valve. The pressure relief valve shall be set at a maximum pressure equal to or less than the rating of the shell of the tank.

1304.5 Design. The design of compressed air piping systems shall conform to accepted engineering practices. Methods utilized to determine pipe sizes shall be approved.

1304.6 Materials, joints and connections.

1304.6.1 Brass. Joints between brass pipe or fittings shall comply with Subsections 1304.6.1.1 through 1304.6.1.4. Brass piping shall conform to ASTM B43.

1304.6.1.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8 and having a melting point of 1,000°F or greater.

1304.6.1.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

1304.6.1.3 Threaded joints. Threaded joints shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied to the male threads only.

1304.6.1.4 Welded joints. All welded joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

1304.6.2 Copper pipe. Copper or copper-alloy pipe joints shall comply with ASTM B42, ASTM B75, ASTM B88, ASTM B302 or ASTM B447, and be a minimum Type L complying with Subsections 1304.6.2.1 through 1304.6.2.4.

1304.6.2.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. All cut tube ends shall be reamed to the full inside diameter of the tube. The joint shall be brazed with a filler metal having a melting point of 1,000°F or greater.

1304.6.2.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

1304.6.2.3 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

1304.6.2.4 Flared joints. Flared joints for copper tubing shall be made with a tool designed for that operation.

1304.6.3 Metallic pipe. Metallic compressed air piping shall be a minimum Schedule 40 steel complying with ASME B36.10, ASTM A53 or ASTM A106/A106M.

CHAPTER 14

REFERENCED STANDARDS

This Chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard.

AHRI Air-Conditioning, Heating and Refrigeration Institute
2111 Wilson Boulevard
Suite 500
Arlington, VA 22201
www.ahrinet.org

Standard reference number	Title	Referenced in code section number
1010—02	Self-Contained, Mechanically Refrigerated Drinking-Water Coolers	410.1

ANSI American National Standards Institute
25 West 43rd Street
4th Floor
New York, NY 10036
www.ansi.org

Standard reference number	Title	Referenced in code section number
A118.10—99	Load Bearing, Bonded, Waterproof Membranes for Thin Set Ceramic Tile and Dimension Stone Installation	417.5.7
Z4.3—95	Minimum Requirements for Non-Sewered Waste-Disposal Systems	311.1
Z21.22—99(R2003)	Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems	504.2, 504.5
Z124.1.2—05	Plastic Bathtub and Shower Units (Note: Z124.1 included in Z124.1.2)	407.1, 417.1
Z124.3—05	Plastic Lavatory Units	416.1, 416.2
Z124.4—06	Plastic Water Closet Bowls and Tanks	420.1
Z124.6—07	Plastic Sinks	415.1, 418.1

ASME American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016
www.asme.org

Standard reference number	Title	Referenced in code section number
A13.1—07	Scheme for the Identification of Piping Systems	608.8
A112.1.2—04	Air Gaps in Plumbing Systems	608.1
A112.6.1M—97(R2008)	Floor-affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use	405.4.3
A112.6.3—01(R2007)	Floor and Trench Drains	412.1
A112.6.4—2003(R2008)	Roof, Deck and Balcony Drains	1102.6
A112.6.9—05(R2010)	Siphonic Roof Drains	1112.1
A112.14.1—03	Backwater Valves	715.3
A112.18.1—11/ CSA B125.1—11	Plumbing Supply Fittings	424.1, 424.5, 424.7
A112.18.3—02(R2008)	Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings	424.7
A112.19.1—13/ CSA B45.2—13	Enameled Cast Iron and Enameled Steel Plumbing Fixtures	407.1, 410.1, 415.1, 416.1, 418.1
A112.19.2—13/ CSA B45.1—13	Ceramic Plumbing Fixtures	405.9, 407.1, 408.1, 409.1, 410.1, 415.1, 416.1, 417.1, 418.1, 419.1, 420.1

REFERENCED STANDARDS

ASME—continued

A112.19.3—08/ CSA B45.4—08(R2013)	Stainless Steel Plumbing Fixtures	415.1, 416.1, 418.1, 420.1
A112.19.4M—99	Porcelain Enameled Formed Steel Plumbing Fixtures	407.1, 416.1, 418.1
A112.19.5—11/ CSA B45.15—11	Flush Valves and Spuds for Water Closets, Urinals, and Tanks	425.4
A112.19.6—95	Hydraulic Performance Requirements for Water Closets and Urinals	419.1, 420.1
A112.19.7—12/ CSA B45.10—12	Hydromassage Bathtub Systems	421.1
A112.19.8—07	Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, Hot Tubs and Whirlpool Bathtub Appliances	421.4
A112.19.9/ A112.19.9M—91(R2002)	Non-vitreous Ceramic Plumbing Fixtures	407.1, 409.1, 410.1, 415.1, 416.1, 417.1, 418.1, 420.1
B1.20.1—1983(R2006)	Pipe Threads, General Purpose (inch)	605.10.3, 605.12.3, 605.14.4, 605.16.3, 605.17.1, 605.20.3, 705.2.3, 705.4.3, 705.7.4, 705.10.1, 705.12.1
B16.3—11	Malleable Iron Threaded Fittings Classes 150 and 300	Table 605.6, Table 702.4, Table 1102.7
B16.4—11	Gray Iron Threaded Fittings Classes 125 and 250	Table 605.6, Table 702.4, Table 1102.7
B16.9—07	Factory-made Wrought Steel Buttwelding Fittings	Table 605.6, Table 702.4, Table 1102.7
B16.11—11	Forged Fittings, Socket-welding and Threaded	Table 605.6, Table 702.4, Table 1102.7
B16.12—09	Cast Iron Threaded Drainage Fittings	Table 605.6, Table 702.4, Table 1102.7
B16.15—11	Cast Bronze Threaded Fittings	Table 605.6, Table 702.4, Table 1102.7
B16.18—12	Cast Copper Alloy Solder Joint Pressure Fittings	Table 605.6, Table 702.4, Table 1102.7
B16.22—01(R2010)	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	Table 605.6, Table 702.4, Table 1102.7
B16.23—11	Cast Copper Alloy Solder Joint Drainage Fittings (DWV)	Table 605.6, Table 702.4, Table 1102.7
B16.26—11	Cast Copper Alloy Fittings for Flared Copper Tubes	Table 605.6, Table 702.4, Table 1102.7
B16.29—12	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings—DWV	Table 605.6, Table 702.4, Table 1102.7
B16.32—92	Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems	Table 605.6, Table 702.4, Table 1102.7
B36.10—04(R2010)	Welding and Seamless Wrought Steel Pipe	1304.6.3

ASPE

American Society of Plumbing Engineers
8614 Catalpa Avenue
Suite 1007
Chicago, IL 60656
www.aspe.org

Standard reference number	Title	Referenced in code section number
45—13	Siphonic Roof Drainage Systems	1112.1

ASSE

American Society of Sanitary Engineering
901 Canterbury
Suite A
Westlake, OH 44145
www.asse-plumbing.org

Standard reference number	Title	Referenced in code section number
1001—08	Performance Requirements for Atmospheric Type Vacuum Breakers	425.2, Table 608.1, 608.13.6
1002—08	Performance Requirements for Antisiphon Fill Valves (Ballcocks) for Gravity Water Closet Flush Tanks	425.3.1, Table 608.1
1003—09	Performance Requirements for Water Pressure Reducing Valves	604.8
1004—08	Performance Requirements for Backflow Prevention Requirements for Commercial Dishwashing Machines	409.1
1005—99	Performance Requirements for Water Heater Drain Valves	501.3
1006—89	Performance Requirements for Residential Use (Household) Dishwashers	409.1
1007—92	Performance Requirements for Home Laundry Equipment	406.1, 406.2
1008—06	Performance Requirements for Plumbing Aspects of Food Waste Disposer Units	413.1
1009—90	Performance Requirements for Commercial Food Waste Grinder Units	413.1
1010—04	Performance Requirements for Water Hammer Arresters—with 1982 Revision	604.9
1011—04	Performance Requirements for Hose Connection Vacuum Breakers	Table 608.1, 608.13.6

ASSE—continued

1012—09	Performance Requirements for Backflow Preventers with Intermediate Atmospheric Vent.	Table 608.1, 608.13.3, 608.16.1, 608.16.2
1013—09	Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers	Table 608.1, 608.13.2, 608.16.2
1014—05	Performance Requirements for Hand-held Showers.	424.3
1015—09	Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire	Table 608.1, 608.13.7
1016—11/ ASME A112.1.016/ CSA B125.16—11	Performance Requirements for Individual Thermostatic, Pressure Balancing and Combination Control Valves for Individual Fixture Fittings	424.4
1018—10	Performance Requirements for Trap Seal Primer Valves; Potable Water Supplied.	1002.4
1019—10	Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Types	Table 608.1, 608.13.6
1020—04	Performance Requirements for Pressure Vacuum Breaker Assembly	Table 608.1, 608.13.5
1024—04	Performance Requirements for Dual Check Valve Type Backflow Preventers (for Residential Supply Service or Individual Outlets)	Table 608.1
1025—78	Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-siphon Type, Residential Applications—Inactive	424.2
1032—04(R2011)	Performance Requirements for Dual Check Valve Type Backflow Preventers for Carbonated Beverage Dispensers—Post-Mix Types	Table 608.1, 608.16.1
1035—08	Performance Requirements for Laboratory Faucet Backflow Preventers	Table 608.1, 608.13.6
1037—90	Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures.	425.2
1044—10	Performance Requirements for Trap Seal Primer Devices; Drainage Type and Electronic Design Types	1002
1047—09	Performance Requirements for Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies	Table 608.1
1048—09	Performance Requirements for Double Check Detector Fire Protection Backflow Prevention Assemblies	Table 608.1, 608.13.7
1049—09	Performance Requirements for Individual and Branch Type Air Admittance Valves for Chemical Waste Systems	917.8
1050—09	Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems	917.1
1051—09	Performance Requirements for Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems—Fixture and Branch Devices.	917.1
1052—04	Performance Requirements for Hose Connection Backflow Preventers	Table 608.1, 608.13.6
1056—10	Performance Requirements for Spill Resistant Vacuum Breaker.	Table 608.1, 608.13.8
1069—05	Performance Requirements for Automatic Temperature Control Mixing Valves	424.5
1070—04	Performance Requirements for Water-Temperature Limiting Devices	408.3, 607.1.2
5010-1013-1—09	Field Test Procedure for a Reduced Pressure Principle Assembly Using a Differential Pressure Gauge—with August 1992 Revisions	312.9
5010-1015-1—09	Field Test Procedure for a Double Check-Valve Assembly Using a Duplex Gauge—with August 1992 Revisions	312.9
5010-1015-2—09	Field Test Procedure for a Double Check-Valve Assembly Using a Differential Pressure Gauge—High- and Low-Pressure Hose Method—with August 1992 Revisions	312.9
5010-1015-3—09	Field Test Procedure for a Double Check-Valve Assembly Using a Differential Pressure Gauge—High-Pressure Hose Method—with August 1992 Revisions	312.9
5010-1015-4—09	Field Test Procedure for a Double Check-Valve Assembly Using a Sight Tube—with August 1992 Revisions	312.9
5010-1020-1—09	Field Test Procedure for a Pressure Vacuum Breaker Assembly.	312.9
5010-1047-1—09	Field Test Procedure for a Reduced Pressure Detector Assembly Using a Differential Pressure Gauge—with August 1992 Revisions	312.9
5010-1048-1—09	Field Test Procedure for a Double Check Detector Assembly Using a Duplex Gauge—with August 1992 Revisions	312.9
5010-1048-2—09	Field Test Procedure for a Double Check Detector Assembly Using a Differential Pressure Gauge—High- and Low-Pressure Hose Method—with August 1992 Revisions	312.9
5010-1048-3—09	Field Test Procedure for a Double Check Detector Assembly Using a Differential Pressure Gauge—High-Pressure Hose Method—with August 1992 Revisions	312.9
5010-1048-4—09	Field Test Procedure for a Double Check Detector Assembly Using a Sight Tube—with August 1992 Revisions	312.9

REFERENCED STANDARDS

ASTM

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428
www.astm.org

Standard reference number	Title	Referenced in code section number
A53/A52M—12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.	Table 605.4, Table 605.5, Table 702.1
A74—13A	Cast-Iron Soil Pipe and Fittings.	Table 702.1, Table 702.2, Table 702.3, Table 702.4, 708.2, Table 1102.4, Table 1102.5
A106/A 106M—14	for Seamless Carbon Steel Pipe for High-Temperature Service	1304.6.3
A312/A312M—13a	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes	Table 605.4, Table 605.5
A733—03(2009)el	Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples	Table 605.8
A778—01(2009)el	Welded, Unannealed Austenitic Stainless Steel Tubular Products.	Table 605.4, Table 605.5
A888—13A	Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Application	Table 702.1, Table 702.2, Table 702.3, Table 702.4, Table 1102.4, Table 1102.5, Table 1102.7
B32—08	Solder Metal.	605.14.3, 605.15.4, 705.7.3, 705.8.3
B42—10	Seamless Copper Pipe, Standard Sizes.	Table 605.4, Table 605.5, Table 702.1
B43—09	Seamless Red Brass Pipe, Standard Sizes	Table 605.4, Table 605.5, Table 702.1
B75—11	Seamless Copper Tube.	Table 605.4, Table 605.5, Table 702.1, Table 702.2, Table 702.3, Table 1102.4
B88—09	Seamless Copper Water Tube	Table 605.4, Table 605.5, Table 702.1, Table 702.2, Table 702.3, Table 1102.4
B152/B152M—13	Copper Sheet, Strip Plate and Rolled Bar	402.3, 425.3.3, 902.2
B251—10	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	Table 605.4, Table 605.5, Table 702.1, Table 702.2, Table 702.3, Table 1102.4
B302—12	Threadless Copper Pipe, Standard Sized.	Table 605.4, Table 605.5, Table 702.1
B306—09	Copper Drainage Tube (DWV)	Table 702.1, Table 1102.4
B447—12a	Welded Copper Tube.	Table 605.4, Table 605.5
B687—99(2011)	Brass, Copper and Chromium-Plated Pipe Nipples.	Table 605.8
B813—10	Liquid and Paste Fluxes for Soldering of Copper and Copper-Alloy Tube	605.14.3, 605.15.4, 705.7.3, 705.8.3
B828—02(2010)	Practice for Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings	605.14.3, 605.15.4, 705.7.3, 705.8.3
C4—04(2009)	Clay Drain Tile and Perforated Clay Drain Tile	Table 702.3, Table 1102.4, Table 1102.5
C14—11	Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe	Table 702.3, Table 1102.4
C76—13a	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe	Table 702.3, Table 1102.4
C425—04(2013)	Compression Joints for Vitrified Clay Pipe and Fittings.	705.13, 705.14
C428—05(2011)	Asbestos-Cement Non-Pressure Sewer Pipe	Table 702.2, Table 702.3
C443—12	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.	705.6, 705.14
C564—12	Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.	705.5.2, 705.5.3, 705.14
C700—13	Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated	Table 702.3, Table 1102.4, Table 1102.5
C1053—00(2010)	Borosilicate Glass Pipe and Fittings for Drain, Waste and Vent (DWV) Applications	Table 702.1, Table 702.4
D1527—99(2005)	Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80	Table 605.4
D1785—12	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120	Table 605.4
	(Note: ASTM D1861—88 has been discontinued and has not been replaced by ASTM.)	
	(Note: ASTM D1862—88 has been discontinued and has not been replaced by ASTM.)	
D2235—04(2011)	Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings	605.10.2, 705.2.2
D2239—12a	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.	Table 605.4
D2241—09	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).	Table 605.4
D2282—99(2005)	Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR).	Table 605.4
	(Note: ASTM D2311—88 has been discontinued and has not been replaced by ASTM.)	

ASTM—continued

D2464—06	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Table 605.6, Table 1102.7
D2466—06	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40	Table 605.6, Table 1102.7
D2467—06	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Table 605.6, Table 1102.7
D2468—96a	Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40	Table 605.6, Table 1102.7
D2564—12	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems	605.20.2, 705.12.2
D2609—02(2008)	Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe	Table 605.6, Table 1102.7
D2657—07	Heat-Joining Polyolefin Pipe and Fitting Waste and Vent Pipe and Fittings	605.18.2, 605.19.2
D2661—11	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste and Vent Pipe and Fittings	Table 702.1, Table 702.2, Table 702.3, 705.2.2, Table 1102.4
D2662—96a	Polybutylene (PB) Plastic Pipe (SDR-PR)	Table 605.4
D2665—12	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings	Table 702.1, Table 702.2, Table 702.3, Table 1102.4
D2666—96a	Polybutylene (PB) Plastic Tubing	Table 605.4
D2672—96a(2009)	Joints for IPS PVC Pipe Using Solvent Cement	Table 605.4
D2729—11	Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	Table 1102.4
D2737—12a	Polyethylene (PE) Plastic Tubing	Table 605.4
D2751—05	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings	Table 702.3, Table 1102.4
D2846/D2846M—09e1	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems	Table 605.4, Table 605.6, 605.16.2
D2855—96(2010)	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings	605.20.2, 705.12.2
D2949—10	3.25-Inch Outside Diameter Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings	Table 702.1, Table 702.2, Table 702.3
D3034—08	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	Table 702.3, Table 1102.4
D3139—98(2011)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals	605.10.1, 605.20.1
D3212—07	Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals	705.2.1, 705.12.1
D3309—97a(2002)	Polybutylene (PB) Plastic Hot Water Distribution Systems	Table 605.4, Table 605.5, 605.18.2, 605.18.3
D3311—11	Drain, Waste and Vent (DWV) Plastic Fittings Patterns	Table 702.4
D4551—12	Poly (Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane	417.5.3
F405—05	Corrugated Polyethylene (PE) Pipe and Fittings	Table 1102.5
F409—12	Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings	Table 702.4, Table 1102.7
F437—09	Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Table 605.6, Table 1102.7
F438—09	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40	Table 605.6, Table 1102.7
F439—12	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Table 605.6, Table 1102.7
F441/F441M—13	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80	Table 605.4, Table 605.5
F442/F442M—13	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)	Table 605.4, Table 605.5
F477—10	Elastomeric Seals (Gaskets) for Joining Plastic Pipe	605.21, 705.14
F493—10	Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings	605.16.2
F628—08	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste and Vent Pipe with a Cellular Core	Table 702.1, Table 702.2, Table 702.3, 705.2.2, Table 1102.4
F656—10	Primers for Use in Solvent-Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings	705.12.2
F876—13	Cross-Linked Polyethylene (PEX) Tubing	Table 605.4
F877—11a	Cross-Linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems	Table 605.4, Table 605.5

REFERENCED STANDARDS

ASTM—continued

F891—10	Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core.	Table 702.1, Table 702.2, Table 702.3, Table 1102.4, Table 1102.5
F1281—11	Cross-Linked Polyethylene/Aluminum/Cross-Linked Polyethylene (PEX-AL-PEX) Pressure Pipe	Table 605.4, Table 605.5
F1282—10	Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe	Table 605.4
F1412—09	Polyolefin Pipe and Fittings for Corrosive Waste Drainage.	917.8
F1488—09e1	Coextruded Composite Pipe	Table 702.1, Table 702.2, Table 702.3
F1807—13	Metal Insert Fittings Utilizing a Copper Crimp Ring SDR 9 Cross-Linked Polyethylene (PEX) Tubing and SDR 9 Polyethylene of Raised Temperature (PE-RT) Tubing	Table 605.6, 605.17.2

AWS

American Welding Society
550 N.W. LeJeune Road
P. O. Box 351040
Miami, FL 33126
www.aws.org

Standard reference number	Title	Referenced in code section number
A5.8/A5.8M—11	Filler Metals for Brazing and Braze Welding	605.12.1, 605.14.1, 605.15.1, 705.4.1, 705.7.1, 705.8.1

AWWA

American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235
www.awwa.org

Standard reference number	Title	Referenced in code section number
C110/A21.10—12	Ductile Iron and Gray Iron Fittings	Table 605.6, Table 702.4, Table 1102.7
C151/A21.51—09	Ductile Iron Pipe, Centrifugally Cast for Water	Table 605.4
C510—07	Double Check-Valve Backflow Prevention Assembly	Table 608.1, 608.13.7
C511—07	Reduced Pressure Principle Backflow Prevention Assembly	Table 608.1, 608.13.2, 608.16.2
C651—05	Disinfecting Water Mains	610.1
C652—11	Disinfection of Water-Storage Facilities	610.1

CISPI

Cast Iron Soil Pipe Institute
1064 Delaware Avenue SE
Atlanta, GA 30316
www.cispi.org

Standard reference number	Title	Referenced in code section number
301—4a	Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications	Table 702.1, Table 702.2, Table 702.3, Table 702.4, Table 1102.4, Table 1102.5
310—04	Coupling for Use in Connection with Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications	705.5.3

CODES

This model code is intended to be utilized in conjunction with the other model codes that are adopted by the jurisdiction.

Standard reference number	Title	Referenced in code section number
	EPCOT Accessibility Code for Building Construction—2018 Edition	404.1, 417.4
	EPCOT Building Code—2018 Edition.	103.4, 103.6, 108.2, 201.3, 305.4, 307.1, 307.2, 307.3, 309.1.1, 309.1.2, 310.1, 310.3, 403.1, Table 403.1, 404.1, 407.3, 417.6, 606.5.2, 1107.5, 1203.1
	EPCOT Electrical Code—2018 Edition	502.1, 1101.7
	EPCOT Energy Efficiency Code for Building Construction—2018 Edition	313.1, 607.2
	EPCOT Fuel Gas Code—2018 Edition	502.1, 1202.1, 1203.1
	EPCOT Mechanical Code—2018 Edition	201.3, 310.1, 502.1, 613.1, 1204.1, 1302.1

CSA

Canadian Standards Association
178 Rexdale Boulevard
Rexdale (Toronto), Ontario
Canada M9W 1R3
www.csa-international.org

Standard reference number	Title	Referenced in code section number
A257.1—09	Circular Concrete Culvert, Storm Drain, Sewer Pipe and Fittings.	Table 702.3, Table 1102.4
A257.2—09	Reinforced L Circular Concrete Culvert, Storm Drain, Sewer Pipe and Fittings.	Table 702.3, Table 1102.4
A257.3—09	Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets	705.6, 705.14
B45.1—13	Ceramic Plumbing Fixtures	408.1, 416.1, 418.1, 419.1, 420.1
B45.2—13	Enameled Cast Iron and Enameled Steel Plumbing Fixtures	407.1, 415.1, 416.1, 418.1
B45.3—02(R2013)	Porcelain Enameled Steel Plumbing Fixtures.	407.1, 416.1, 418.1
B45.4—02(R2013)	Stainless Steel Plumbing Fixtures.	415.1, 416.1, 418.1, 420.1
B45.5—17	Plastic Plumbing Fixtures	407.1, 416.2, 417.1, 419.1, 420.1, 421.1
B45.10-12/ASME A112.19.7—12	Hydromassage Bathtubs Systems	421.1
B64.1.1—11	Vacuum Breakers, Atmospheric Type (AVB)	425.2, Table 608.1, 608.13.6
B64.2—11	Vacuum Breakers, Hose-Connection Type (HCVB)	Table 608.1, 608.13.6
B64.2.2—11	Vacuum Breakers, Hose-Connection Type (HCVB) with Automatic Draining Feature	Table 608.1, 608.13.6
B64.3—11	Backflow Preventers, Dual Check-Valve Type with Atmospheric Port (DCAP).	Table 608.1, 608.13.3, 608.15.2
B64.4—11	Backflow Preventers, Reduced Pressure Principle Type (RP)	Table 608.1, 608.13.2, 608.15.2
B64.7—11	Laboratory Faucet Vacuum Breakers (LFVB)	Table 608.1, 608.13.6
B64.10—11	Manual for the Selection and Installation of Backflow Prevention Devices	312.9
B79—08(R2013)	Commercial and Residential Drains and Cleanouts	412.1
B125.3—12	Plumbing Fittings	408.8, 424.1, 424.2, 424.3, 424.4, 424.5, 424.6, 425.3.1, 425.4, Table 608.1
B137.1—13	Polyethylene (PE) Pipe, Tubing and Fittings for Cold Water Pressure Services	Table 605.4
B137.2—13	Polyvinylchloride PVC Injection-Moulded Gasketed Fittings for Pressure Applications.	Table 605.6, Table 1102.7
B137.3—13	Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications	Table 605.4, 605.20.2, 705.12.2
B137.5—13	Cross-Linked Polyethylene (PBX) Tubing Systems for Pressure Applications.	Table 605.4, Table 605.5
B137.6—13	CPVC Pipe, Tubing and Fittings for Hot and Cold Water Distribution Systems.	Table 605.4, Table 605.5
B137.8—13	Polybutylene (PB) Piping for Pressure Applications —with Revisions through July 1992	Table 605.4, Table 605.5, 605.18.2, 605.18.3
B137.9—13	Polyethylene/Aluminum/Polyethylene Composite Pressure Pipe Systems	Table 605.4
B137.10—13	Cross-Linked Polyethylene/Aluminum/Polyethylene Composite Pressure Pipe Systems	Table 605.4, Table 605.5
B181.1—11	Acrylonitrile-Butadiene-Styrene ABS Drain, Waste and Vent Pipe and Pipe Fittings	Table 702.1, Table 702.2, Table 702.4, 705.2.2, 715.3

REFERENCED STANDARDS

CSA—continued

B181.2—11	Polyvinylchloride PVC and Chlorinated Polyvinylchloride (CPVC) Drain, Waste and Vent Pipe and Pipe Fittings	Table 702.1, Table 702.2, 705.12.2, 715.3
B181.3—11	Polyolefin and Polyvinylidene Fluoride (PVDF) Laboratory Drainage Systems	Table 702.1, Table 702.2
B182.1—11	Plastic Drain and Sewer Pipe and Pipe Fittings.	705.12.2
B182.2—11	PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.	Table 702.3, Table 1102.4, Table 1102.5
B182.4—11	Profile Polyvinylchloride PVC Sewer Pipe and Fittings.	Table 702.3, Table 1102.4, Table 1102.5
B602—10	Mechanical Couplings for Drain, Waste and Vent Pipe and Sewer Pipe	705.2.1, 705.5.3, 705.6, 705.12.1, 705.13, 705.14

GSA

General Services Administration
1800 F Street, NW
Washington, DC 20405
www.gsa.gov

Standard reference number	Title	Referenced in code section number
A-A3110—97	Federal Specification for Plumbing Fixture Setting Compound (Superseding TT-P-1536a—75) (Canceled)	405.4

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169
www.nfpa.org

Standard reference number	Title	Referenced in code section number
50—01	Bulk Oxygen Systems at Consumer Sites—Withdrawn	1303.1
51—13	Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes	1303.1
70—14	National Electrical Code	502.1, 1111.3.3
99C—05	Gas and Vacuum Systems	1302.1

NIST

National Institute of Standards and Technology
[Formerly National Bureau of Standards (NBS)]
100 Bureau Drive
Stop 1070
Gaithersburg, MD 20899
www.nist.gov

31	NSB Monograph 31	Table 916.5.1
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NSF

NSF International
789 N. Dixboro Road
P.O. Box 130140
Ann Arbor, MI 48113
www.nsf.org

Standard reference number	Title	Referenced in code section number
14—11	Plastic Piping System Components and Related Materials	303.3
42—11	Drinking Water Treatment Units—Aesthetic Effects	611.1
53—11a	Drinking Water Treatment Units—Health Effects	611.1
58—12	Reverse Osmosis Drinking Water Treatment Systems	611.2
61—12	Drinking Water System Components—Health Effects	605.4, 605.5, 605.6

PDI

Plumbing & Drainage Institute
800 Turnpike Street
Suite 300
North Andover, MA 01845
www.pdionline.org

Standard reference number	Title	Referenced in code section number
G101—12	Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data	1003.3

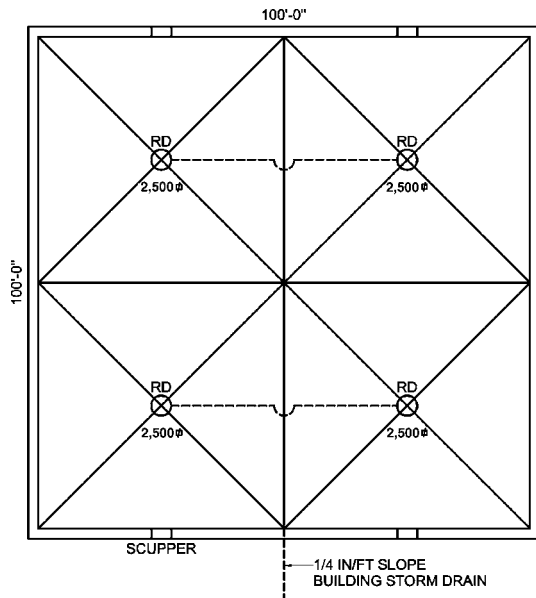
APPENDIX A

SCUPPER SIZING METHOD

SECTION A-101 SIZING EXAMPLE

A-101.1 Example. The following example gives one method of sizing the scuppers in the parapet walls.

A-101.2 Problem. Given the roof plan in Figure A-101 and the site location in the District, size the scuppers, denoting the required head of water above the scupper for the structural engineer.



**FIGURE A-101
EXAMPLE ROOF PLAN**

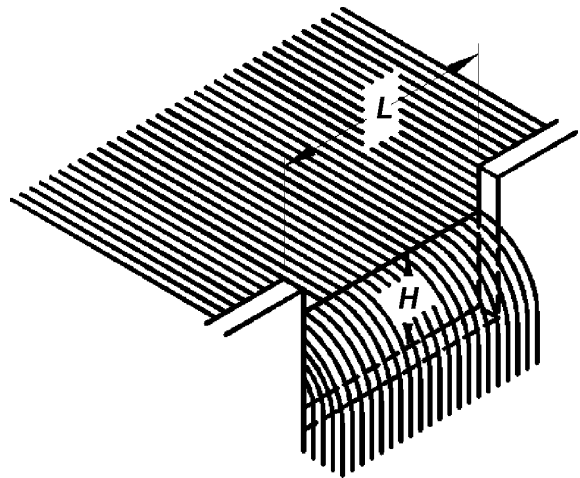
A-101.3 Solution.

Step 1. From Subsection 1107.4, the rate caused by a 100-year, 15-minute precipitation is 8 inches per hour. The scuppers must be sized to carry the flow caused by a rainfall rate of 8 inches per hour.

Step 2. Each scupper is draining 2,500 square feet of roof area.

- (a) Review Table A-101 to find a length and head that will carry 2,500 square feet or more.
- (b) From Table A-101, a 12-inch-wide weir with a 4-inch head carries 3,230 square feet. (See length of weir and head to be used in scupper sizing in Figure A-102.)
- (c) Use 12-inch-wide by 5-inch-high scuppers at four locations.
- (d) A height of 5 inches is needed to ensure an open area above the 4-inch head.

Step 3. Notify the structural engineer that the design of the roof structure must account for a height of water to the scupper entrance elevation plus 4 inches for the required head to cause design flow.



**FIGURE A-102
LENGTH OF WEIR AND HEAD TO BE USED
FOR SCUPPER SIZING**

**TABLE A-101^a
SCUPPER SIZING TABLE ROOF AREA (square feet)**

HEAD (H) (inches)	LENGTH (L) OF WEIR (inches)						
	4	6	8	12	16	20	24
4	923	1,500	2,076	3,230	4,383	5,537	6,691
6	1,483	2,544	3,602	5,721	7,840	9,959	12,080
8	1,845	2,999	4,152	6,460	8,766	11,073	13,381

Note: Table based on rainfall of 8 inches per hour.

a. See Subsection 903.3 of the *EPCOT Building Code*.

APPENDIX B

TRAVEL TRAILERS AND TRAVEL TRAILER PARKS

SECTION B-101 GENERAL

B-101.1 Requirements. The requirements set forth in this Appendix shall apply specifically to all new travel trailer parks, and to additions to existing parks as herein defined, and are to provide minimum standards for sanitation and plumbing installations within these parks, for the accommodations, use and parking of travel trailers. Plumbing installations in travel trailers shall be installed in accordance with Part I of ANSI A119.2.

SECTION B-102 DEFINITIONS

B-102.1 Definitions. Definitions contained in Chapter 2 shall also apply to this Appendix, except where the following special definitions shall apply.

- (a) **Air lock.** A condition where air is trapped in a drain or drain hose and retards or stops the flow of liquid waste or sewage.
- (b) **Center.** Of a manufactured home or travel trailer is the longitudinal centerline located midway between the right and left side.
- (c) **Combination compartment.** A shower stall with or without a door that provides for or includes a water closet. It is sized for the occupancy of only one person.
- (d) **Department having jurisdiction.** The Reedy Creek Improvement District.
- (e) **Dependent travel trailer.** A trailer coach not equipped with a water closet.
- (f) **Drain hose.** The approved-type hose, flexible and easily detachable, used for connecting the drain outlet to a sewer inlet connection.
- (g) **Drain outlet.** The lowest end of the main drain to which the terminal end of the drain hose is connected.
- (h) **Independent mobile home or travel trailer.** One equipped with a water closet and a bath or shower.
- (i) **Inlet coupling.** The terminal end of the water system to which the water service connection is made. It may be a swivel fitting or threaded pipe end.
- (j) **Intermediate waste holding tank.** (Travel trailers only) an enclosed tank for the temporary retention of water-borne waste.
- (k) **Length.** The distance measured from the tip of the hitch to the part farthest to the rear of a manufactured home or travel trailer.
- (l) **Manufactured home or travel trailer park.** A site, lot, tract or parcel of land upon which one or more mobile homes or travel trailers are parked, for the temporary or permanent use as living quarters of one or more families.
- (m) **Park drainage system.** The entire system of drainage piping used to convey sewage or other wastes from the manufactured home or travel trailer drain outlet connection, at its connection to the manufactured home or travel trailer site, to a public sewer or private sewage disposal system.
- (n) **Park Water supply system.** All of the water supply piping within the park, extending from the main public supply or other source of supply to, but not including, the manufactured home or travel trailer service system, and including branch service lines, fixture devices, service buildings and appurtenances thereto.
- (o) **Service building.** A building housing toilet and bathing facilities for men and women, with laundry facilities.
- (p) **Sewer lateral.** That portion of the park drainage system extending to a manufactured home or travel trailer site.
- (q) **Travel trailer.** A vehicular, portable structure built on a chassis, designed to be used as a temporary dwelling for travel, recreational and vacation uses, permanently identified "Travel Trailer" by the manufacturer on the trailer; and, when factory-equipped for the road, having a body width not exceeding 8 feet and being of any length, provided its gross weight does not exceed 4,500 pounds, or being of any weight provided its overall length does not exceed 29 feet.
- (r) **Travel trailer sanitary service station.** One used for emptying waste holding tanks.

SECTION B-103 TRAVEL TRAILER PARKS

B-103.1 Governing provisions. The general provisions of this Code shall govern the installation of plumbing systems in travel trailer parks, except where special conditions or construction are specifically defined in this Appendix.

B-103.2 Travel trailer sites.

B-103.2.1 Plumbing. Travel trailers shall not hereafter be parked in any travel trailer park unless there are provided plumbing and sanitation facilities installed and maintained in compliance with these regulations. Every travel trailer shall provide a gas-tight and water-tight connection for sewage disposal, which shall be connected to an underground sewage collection system discharging into a public or private disposal system.

B-103.2.2 Sanitation. No dependent travel trailer shall be parked at any time in a space designed and designated for an independent travel trailer, unless public toilet and bath facilities are available within 200 feet of the dependent travel trailer.

SECTION B-104 PLANS AND SPECIFICATIONS

B-104.1 Permits. The owner or operator of every travel trailer park, before providing areas of space for the use and accommodation of independent travel trailers, shall submit an application for a permit and file two sets of plans and specifications with the Department of Building and Safety. The plans and specifications shall be in detail as follows:

- (a) A scaled plot plan of the park, indicating the spaces, area or portion of the park for the parking of independent travel trailers.
- (b) Size, location and specification of the park drainage system.
- (c) Size, location and specification of the water supply lines.
- (d) Size, location and layout of the service building.
- (e) Size, location, specification and layout of the fire protection system.
- (f) A scaled layout of typical trailer sites.
- (g) The applicant shall secure the approval of such a proposed park or area from the Department of Planning and Engineering, and such other agencies, as may be necessary before a permit will be issued by the Department of Building and Safety.
- (h) Plumbing required herein shall comply with this Code.
- (i) The issuance of a permit shall not constitute approval of any violation of any regulation or code.
- (j) An approved set of plans and a copy of the permit shall be kept on the park premises until the final inspection has been made by the Building Official.

SECTION B-105 SERVICE BUILDINGS

B-105.1 Minimum facilities.

B-105.1.1 Required. Each travel trailer park shall have at least one service building to provide necessary sanitation and laundry facilities. Those parks serving independent travel trailers need provide only minimum facilities. However, a service building with adequate laundry facilities and storage locker rooms is most desirable.

B-105.1.2 Construction. The service building shall be of permanent construction with an interior finish of moisture-resistant material that will stand frequent washing and cleaning, and the building shall be well-lighted and ventilated at all times.

B-105.2 Independent trailers. The service buildings that serve only independent travel trailer parks shall have a minimum of one laundry tray; one water closet, one lavatory, and one shower or bathtub for women; and one water closet, one lavatory, and one shower or bathtub for men.

B-105.3 Dependent trailers. The service buildings serving parks that also accommodate dependent travel trailers shall have a minimum of one laundry tray; two water closets, one lavatory, and one shower or bathtub for women; one water closet, one urinal, and one shower or bathtub for men; and

one slop-water closet for emptying containers of human waste. These facilities will accommodate a maximum of 10 dependent travel trailers. For every 10 or fraction thereof of additional dependent travel trailers, the following additional fixtures shall be provided: one laundry and one shower or bathtub for each sex; one water closet for every 10 or fraction thereof of additional dependent travel trailers for women; and one water closet for every 15 additional dependent travel trailers for men.

B-105.4 Water supply for fixtures.

B-105.4.1 Sanitation. Hot and cold water shall be provided for all fixtures, except water closets. The slop-water closet shall be provided with hot and cold water faucets over the bowl, in addition to the flushing mechanism (preferably a flushometer valve).

B-105.4.2 Compartments. Each water closet, slop-water closet, tub and shower shall be in a separate compartment, with self-closing doors on all water closet compartments. The shower stall shall be a minimum of 3 feet by 3 feet in area, with a dressing compartment that includes a stool or bench for women.

B-105.4.3 Laundry facilities. The laundry trays and washing machines shall be contained in a room separate from the toilet rooms.

B-105.5 Floor drains. A minimum 3-inch floor drain shall be installed in each toilet room and laundry room.

SECTION B-106 MATERIALS

B-106.1 Fixtures or devices. Unless otherwise provided for in this Appendix, all piping fixtures or devices used in the installation of drainage and water supply systems for travel trailer parks, or parts thereof, shall conform to the quality and weights of materials required by this Code.

SECTION B-107 GENERAL REGULATIONS

B-107.1 Plumbing systems. Unless otherwise provided for in this Appendix, all plumbing fixtures, piping, drains, appurtenances and appliances designed and used in a park drainage, water supply system and service connections shall be installed in compliance with this Code.

SECTION B-108 PARK DRAINAGE SYSTEM

B-108.1 Sanitary sewer. The main sewer and sewer laterals shall be installed in a separate trench not less than 5 feet from the park water service or distribution system. (See Subsection 608.3.)

B-108.2 Minimum sizes. The minimum size of pipe in any travel trailer park drainage system shall be 4 inches.

B-108.3 Fixture units. Each travel trailer shall be considered six fixture units when determining discharge requirements in the design of the park drainage and sewage disposal systems.

B-108.4 Flow rate. Minimum grade for sewers shall be so designed that the flow will have a mean velocity of 2 feet per second when the pipe is flowing half full.

B-108.5 Discharge. The discharge of a park drainage system shall be connected to a public sewer. Where a public sewer is not available, an individual sewage disposal system shall be installed of a type that is acceptable and approved by the administrative authority or other law enforcement agency having jurisdiction over this regulation.

B-108.6 Manholes and cleanouts. Manholes and cleanouts shall be provided as required in Chapter 7. Manholes and cleanouts shall be accessible and brought to grade.

B-108.7 Venting. The main sewer shall be provided with a minimum 4-inch vent, not more than 5 feet downstream from its upper trap. Long mains shall be provided with additional relief vents at intervals of not more than 200 feet thereafter, if the manhole covers are not of the perforated type. These relief vents shall be a minimum of 4 inches and shall be securely supported and extended a minimum of 10 feet above the ground.

B-108.8 Branch lines. Branch lines or sewer laterals to individual travel trailers shall be not less than 4 inches in diameter.

B-108.9 Inlets. Sewer inlets shall be a 4-inch diameter and extend above grade 3 inches to 6 inches. Each inlet shall be provided with a gas-tight seal when connected to a trailer and have a gas-tight seal plug for use when not in service.

B-108.10 Traps and laterals. Each trailer site shall be provided with a house trap. Sewer laterals greater than 30 feet from the main park drainage sewer shall be properly vented and provided with a cleanout brought to grade.

B-108.11 Drain inlets. To provide the shortest possible drain connection between the travel trailer outlet and drain inlet, all drain inlets shall terminate with reference to the site location of the travel trailer.

B-108.12 Drain connections. Drain connection shall slope continuously downward and form no traps. All pipe joints and connections shall be installed and maintained gas tight and water tight.

B-108.13 Environmental concerns. No sewage, waste water or any other effluent shall be allowed to be deposited on the surface of the ground.

B-108.14 Testing the system. Upon completion and before covering, the park drainage system shall be subjected to a static water test. The water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged, except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested, so that no joint or pipe in the system shall have been submitted to a test of less than a 10-foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts; the system shall then be tight at all points.

SECTION B-109 WATER DISTRIBUTION SYSTEM

B-109.1 General. Every travel trailer site shall be provided with an individual branch service line delivering safe, pure and potable water. The outlet of the branch service line shall terminate on the left side of the site of the travel trailer.

B-109.2 Minimum size. Water service lines to each trailer site shall be sized to provide a minimum of 8 gallons per minute at the point of connection with the trailer distribution system.

B-109.3 Backflow and service shutoff.

B-109.3.1 Installation. A backpressure backflow preventer or reduced pressure principle backflow preventer shall be installed on the branch service line to each independent trailer at, or near, the trailer service connection. Backflow preventive devices shall be of an approved type, certified by a recognized testing agency as to the compliance and performance outlined herein. Valves shall be designed and maintained to close drip tight at a reduced pressure of not less than 1 nor more than 5 pounds per square inch. Valves must be identified with the manufacturer's name and model number.

B-109.3.2 Shutoff. A separate service shutoff valve shall be installed in each branch service line on the supply side of the backflow protective device.

B-109.4 Service connections. The service connection shall be not less than a 1/2-inch diameter; no rigid pipe may be used. Flexible metal tubing is permitted. Fittings at either end shall be of a quick-disconnect type not requiring any special tools or knowledge to install or remove.

SECTION B-110 TRAVEL TRAILER CONNECTIONS

B-110.1 Responsibility. When it is evident that there exists, or may exist, a violation of these rules, the owner, operator, lessee, person in charge of the park, or any other person causing a violation shall cause it to be corrected immediately or disconnect the service connection and travel trailer drain connection from the respective park branch service line and sewer lateral.

B-110.2 Drain connections. Travel trailer drain connections shall be of approved, semi-rigid or flexible reinforced hose having smooth interior surfaces of not less than 3 inches inside diameter. Drain connections shall be equipped with a standard quick-disconnect screw or clamp-type fitting, not less in size than the outlet. Drain connections shall be gas tight and no longer than necessary to make the connection between the travel trailer outlet and the trap inlet on the site.

APPENDIX C

GRAYWATER RECYCLING SYSTEMS

SECTION C-101 GRAYWATER RECYCLING SYSTEMS

C-101.1 General. Graywater recycling systems shall only receive the waste discharge of bathtubs, showers, lavatories, clothes washers and laundry sinks. Recycled graywater shall only be utilized for flushing water closets and urinals that are located in the same building as the graywater recycling system. Such systems shall comply with Subsections C-101.2 through C-101.12.

Exception: Graywater systems shall be permitted to be used for irrigation when specific approval is given by the authority having jurisdiction. Such systems shall be designed as required by Section 105.

C-101.2 Definition. The following term shall have the meaning shown herein.

(a) **Graywater.** Waste water discharged from lavatories, bathtubs, showers, clothes washers and laundry sinks.

C-101.3 Installation. All drain, waste and vent piping associated with graywater recycling systems shall be installed in full compliance with this Code.

C-101.4 Reservoir. Graywater shall be collected in an approved reservoir constructed of durable, nonabsorbent and corrosion-resistant materials. The reservoir shall be a closed and gas-tight vessel. Access openings shall be provided to allow inspection and cleaning of the reservoir interior. The holding capacity of the reservoir shall be a minimum of twice the volume of water required to meet the daily flushing requirements of the fixtures supplied with graywater, but not less than 50 gallons. The reservoir shall be sized to limit the retention time of graywater to 72 hours maximum.

C-101.5 Filtration. Graywater entering the reservoir shall pass through an approved filter, such as a media, sand or diatomaceous earth filter.

C-101.6 Disinfection. Graywater shall be disinfected by an approved method that employs one or more disinfectants, such as chlorine, iodine or ozone.

C-101.7 Makeup water. Potable water shall be supplied as a source of makeup water for the graywater system. The potable water supply shall be protected against backflow in accordance with Section 608. There shall be a full-open valve on the makeup water supply line to the reservoir.

C-101.8 Overflow. The collection reservoir shall be equipped with an overflow pipe of the same diameter as the influent pipe for the graywater system. The overflow shall be directly connected to the sanitary drainage system.

C-101.9 Drain. A drain shall be located at the lowest point of the collection reservoir and shall be directly connected to the sanitary drainage system. The drain shall be the same diameter as the overflow pipe required by Subsection C-101.8 and shall be provided with a full-open valve.

C-101.10 Vent required. The reservoir shall be provided with a vent sized in accordance with Chapter 9 based on the size of the reservoir influent pipe.

C-101.11 Coloring. Graywater shall be dyed blue or green with a food-grade vegetable dye before such water is supplied to the fixtures.

C-101.12 Identification. All graywater distribution piping and reservoirs shall be identified as containing nonpotable water. Piping identification shall be in accordance with Subsection 608.8.

APPENDIX D

MANUFACTURED HOMES AND MANUFACTURED HOME PARKS

SECTION D-101

PURPOSE, APPLICATION AND SCOPE

D-101.1 Scope. The requirements set forth in this Appendix shall apply specifically to all new manufactured home parks, and to additions to existing parks as herein defined, and are to provide minimum standards for sanitation and plumbing installation within these parks, for the accommodation, use and parking of manufactured homes. Plumbing installations in manufactured homes shall be installed in accordance with Part II of ANSI A119.2.

D-101.2 Seals. All manufactured homes shall bear the seal of approval by the State of Florida Department of Community Affairs.

SECTION D-102

DEFINITIONS

D-102.1 General. Definitions contained in Chapter 2 and Section B-102 shall also apply to this Appendix, except where the following special definition shall apply.

- (a) **Manufactured home.** A vehicular, portable structure built on a chassis and designed to be used as a dwelling without a permanent foundation when connected to indicated utilities in accordance with ANSI A119.2.

SECTION D-103

GENERAL REGULATIONS

D-103.1 Code requirements. The general provisions of this Code shall govern the installation of plumbing systems in manufactured home parks, except where special conditions or construction are specifically defined in this Appendix.

D-103.2 Conditions. Manufactured homes shall not hereafter be parked in any manufactured home park unless plumbing and sanitation facilities have been installed and maintained in compliance with these regulations. Every manufactured home shall provide a gas-tight and water-tight connection for sewage disposal, which shall be connected to an underground sewage collection system discharging into a public or private disposal system.

SECTION D-104

PLANS AND SPECIFICATIONS

D-104.1 Permit application. The owner or operator of every manufactured home park, or the plumbing contractor employed by the owner shall, before providing areas of space for the use and accommodation of independent manufactured homes, submit an application for a permit and file two sets of plans and specifications with the Chief Plumbing Inspector. The plans and specifications shall be in detail as follows:

- (a) A scaled plot plan of the park, indicating the spaces, area or portion of the park for the parking of independent manufactured homes.
- (b) Size, location and specification of the park drainage system.
- (c) Size, location and specification of the water supply lines.
- (d) Size, location and layout of the service building. (See Section D-110.)
- (e) Size, location, specification and layout of the fire protection system.
- (f) A scaled layout of typical manufactured home sites.
- (g) The applicant shall secure the approval of such proposed park or area from the Department of Planning and Engineering, and such other agencies, as may be necessary before a permit will be issued by the Department of Building and Safety.
- (h) Plumbing required herein shall comply with this Code.
- (i) The issuance of a permit shall not constitute approval of any violation of any District regulation or code.
- (j) An approved set of plans and a copy of the permit shall be kept on the park premises until the final inspection has been made by the Building Official.

SECTION D-105

MATERIALS

D-105.1 General. Unless otherwise provided for in this Appendix, all piping fixtures or devices used in the installation of drainage and water supply systems for manufactured home parks, or parts thereof, shall conform to the quality and weights of materials required by this Code.

SECTION D-106

GENERAL REGULATIONS

D-106.1 Installation. Unless otherwise provided for in this Appendix, all plumbing fixtures, piping, drains, appurtenances and appliances designed and used in a park drainage, water supply system and service connections shall be installed in compliance with this Code.

SECTION D-107

PARK DRAINAGE SYSTEM

D-107.1 Minimum system.

D-107.1.1 Sanitary sewer. The main sewer and sewer laterals shall be installed in a separate trench not less than 5 feet from the park water service or distribution system. (See Subsection 603.2.)

D-107.1.2 Minimum sizes. The minimum size of pipe in any manufactured home park drainage system shall be 4 inches.

D-107.1.3 Fixture units. Each manufactured home shall be considered 15 fixture units when determining discharge requirements in the design of park drainage and sewage disposal systems.

D-107.1.4 Flow rate. Minimum grade for sewers shall be so designed that the flow will have a mean velocity of 2 feet per second when the pipe is flowing half full.

D-107.2 Discharge. The discharge of a park drainage system shall be connected to a public sewer. Where a public sewer is not available, an individual sewage disposal system shall be installed of a type that is acceptable and approved by the Chief Plumbing Inspector or other law enforcement agency having jurisdiction over this regulation.

D-107.3 Manholes and cleanouts. Manholes and cleanouts shall be provided as required in Chapter 7. Manholes and cleanouts shall be accessible and brought to grade.

D-107.4 Inlets. Sewer inlets shall be 4 inches in diameter and extend above grade 3 inches to 6 inches. Each inlet shall be provided with a gas-tight seal when connected to a manufactured home and have a gas-tight seal plug for use when not in service.

D-107.5 Unit site requirements.

D-107.5.1 Traps and laterals. Each manufactured home site shall be provided with a house trap. Sewer laterals greater than 30 feet from the main park drainage sewer shall be properly vented and provided with a cleanout brought to grade.

D-107.5.2 Drain inlets. To provide the shortest possible drain connection between the manufactured home outlet and drain inlet, all drain inlets shall terminate in the rear one-third of the manufactured home as placed on the site.

D-107.5.3 Drain connections. Drain connections shall slope continuously downward and form no traps. All pipe joints and connections shall be installed and maintained gas tight and water tight.

D-107.5.4 Environmental concerns. No sewage, waste water or any other effluent shall be allowed to be deposited on the surface of the ground.

D-107.6 Testing the system. Upon completion and before covering, the park drainage system shall be subjected to a static water test and inspected by the Chief Plumbing Inspector. The water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged, except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested

so that no joint or pipe in the system shall have been submitted to a test of less than a 10-foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts; the system shall then be tight at all points.

SECTION D-108 WATER DISTRIBUTION SYSTEM

D-108.1 General. Every manufactured home site shall be provided with an individual branch service line delivering safe, pure and potable water. The outlet of the branch service line shall terminate on the left side of the site of the manufactured home.

D-108.2 Minimum size. Water service lines to each manufactured home site shall be sized to provide a minimum of 17 gallons per minute at the point of connection with the manufactured home distribution system. The minimum size of the branch service line to each site shall be $\frac{3}{4}$ inch.

D-108.3 Installation. A backpressure backflow preventer or reduced pressure principle backflow preventer shall be installed on the branch service line to each independent manufactured home at, or near, the manufactured home service connection. Backflow preventive devices shall be of an approved type, certified by a recognized testing agency as to the compliance and performance outlined herein. Valves shall be designed and maintained to close drip tight at a reduced pressure of not less than 1 nor more than 5 pounds per square inch. Valves shall be identified with the manufacturer's name and model number.

D-108.4 Shut off. A separate service shutoff valve shall be installed in each branch line on the supply side of the backflow protective device.

D-108.5 Service connections. The service connection shall be not less than $\frac{1}{2}$ -inch diameter; no rigid pipe may be used. Flexible metal tubing is permitted. Fittings at either end shall be of a quick-disconnect type not requiring any special tools or knowledge to install or remove.

D-108.6 Minimum supply. The water supply system shall be designed to provide a minimum of 150 gallons per day for each manufactured home, plus such additional volume as may be required for the fire protection of the park, service buildings and other community facilities.

SECTION D-109 MANUFACTURED HOME CONNECTIONS

D-109.1 Responsibility. When it is evident that there exists, or may exist, a violation of these rules, the owner, operator, lessee, person in charge of the park, or any other person causing a violation shall cause it to be corrected immediately or disconnect the service connections and manufactured home drain connection from the respective park branch service line and sewer lateral.

D-109.2 Drain connections. Manufactured home drain connections shall be of approved semi-rigid pipe having smooth

interior surfaces of not less than a 3-inch inside diameter. Drain connections shall be equipped with a standard quick-disconnect screw, clamp-type fitting or solvent welder, not less in size than the outlet. Drain connections shall be gas tight and no longer than necessary to make the connection between the manufactured home outlet and the inlet on the site.

SECTION D-110 SERVICE BUILDINGS

D-110.1 Required. Each manufactured home park shall have at least one service building to provide necessary sanitation and laundry facilities. Those parks serving only independent travel trailers need provide only minimum facilities.

D-110.2 Construction. The service building shall be of permanent construction with an interior finish of moisture-resistant material that will stand frequent washing and cleaning, and the building shall be well-lighted and ventilated at all time.

D-110.3 Independent manufactured homes. The service buildings serving only independent manufactured home parks shall have a minimum of one laundry trap; one water closet, one lavatory, and one shower or bathtub for women; and one water closet, one lavatory, and one shower or bathtub for men.

D-110.4 Sanitation. Hot and cold water shall be provided for all fixtures, except water closets. The slop-water closet shall be provided with hot and cold water faucets over the bowl, in addition to the flushing mechanism.

D-110.5 Compartments. Each water closet, slop-water closet, tub and shower shall be in separate compartments, with self-closing doors on all water closet compartments. The shower stall shall be a minimum of 3 feet by 3 feet in area, with a dressing compartment that includes a stool or bench for women.

D-110.6 Laundry facilities. The laundry trays and washing machines shall be contained in a room separate from the toilet rooms.

D-110.7 Floor drains. A minimum 3-inch floor drain shall be installed in each toilet room and laundry room.

SECTION D-111 MAINTENANCE

D-111.1 General. All devices or safeguards required by this Appendix shall be maintained in good working order by the owner, operator or lessee of the manufactured home park, or his designated agent.

APPENDIX E

SIZING OF WATER PIPING SYSTEM

SECTION E-101 GENERAL

E-101.1 Scope.

E-101.1.1 This Appendix outlines two procedures for sizing a water piping system. (See Subsections E-103.3 and E-201.1.) The design procedures are based on the minimum static pressure available from the supply source, the head charges in the system caused by friction and elevation, and the rates of flow necessary for the operation of various fixtures.

E-101.1.2 Because of the variable conditions encountered in hydraulic design, it is impractical to specify definite and detailed rules for the sizing of the water piping system. Accordingly, other sizing or design methods conforming to good engineering practice standards may be acceptable alternatives to those presented herein.

SECTION E-102 INFORMATION REQUIRED

E-102.1 Preliminary. Obtain the necessary information regarding the minimum daily static service pressure in the area where the building is to be located. If the building supply is to be metered, obtain information regarding the friction loss relative to the rate of flow for meters in the range of sizes likely to be used. Friction loss data can be obtained from most manufacturers of water meters.

E-102.2 Demand load.

E-102.2.1 Estimate the supply demand of the building main, and the principal branches and risers of the system, by totaling the corresponding demand from the applicable part of Table E-103.3(3).

E-102.2.2 Estimate continuous supply demands in gallons per minute (gpm) for lawn sprinklers, air conditioners, etc., and add the sum to the total demand for fixtures. The result is the estimated supply demand for the building supply.

SECTION E-103 SELECTION OF PIPE SIZE—METHOD 1

E-103.1 General. Using Table 604.3, decide what the desirable minimum residual pressure should be at to maintain the highest fixture in the supply system. If the highest group of fixtures contains flush valves, the pressure for the group should not be less than 15 pounds per square inch (psi) flowing. For flush tank supplies, the available pressure should not be less than 8 psi flowing, except blowout action fixtures must not be less than 25 psi flowing.

E-103.2 Pipe sizing.

E-103.2.1 Pipe sizes can be selected according to the following procedure, or by other design methods conforming to acceptable engineering practice and approved by the administrative authority. The sizes selected must not be less than the minimum required by this Code.

E-103.2.2 Water pipe sizing procedures are based on a system of pressure requirements and losses, the sum of which must not exceed the minimum pressure available at the supply source. These pressures are as follows:

- (a) Pressure required at the fixture to produce required flow. (See Subsections 604.3 and 604.5.)
- (b) Static pressure loss or gain (due to head) is computed at 0.433 psi per foot of elevation change.

Example: Assume that the highest fixture supply outlet is 20 feet above or below the supply source. This produces a static pressure differential of 20 feet by 0.433 psi per foot and an 8.66-psi loss.

- (c) Loss through water meter. The friction or pressure loss can be obtained from meter manufacturers.
- (d) Loss through taps in water main.
- (e) Losses through special devices, such as filters, softeners, backflow prevention devices and pressure regulators. These values must be obtained from the manufacturers.
- (f) Loss through valves and fittings. Losses for these items are calculated by converting to an equivalent length of piping and adding to the total pipe length.
- (g) Loss due to pipe friction can be calculated when the pipe size, pipe length and flow through the pipe are known. With these three items, the friction loss can be determined. For piping flow charts not included, use the manufacturer's tables and velocity recommendations.

E-103.3 Segmented loss method. The size of water service mains, branch mains and risers by the segmented loss method must be determined according to the water supply demand (gpm), available water pressure (psi), and friction loss caused by the water meter and developed length of pipe (feet), including the equivalent length of fittings. This design procedure is based on the following parameters:

- (a) Calculate the friction loss through each length of the pipe.
- (b) Based on a system of pressure losses, the sum of which must not exceed the minimum pressure available at the street main or other source of supply.

- (c) Pipe sizing based on estimated peak demand; total pressure losses caused by differences in elevation, equipment, developed length and pressure required at the most remote fixture; loss through taps in the water main; losses through fittings, filters, backflow prevention devices, valves and pipe friction.

Because of the variable conditions encountered in hydraulic design, it is impractical to specify definite and detailed rules for the sizing of the water piping system. Current sizing methods do not address the differences in the probability of use and flow characteristics of fixtures between types of occupancies. Creating an exact model for predicting the demand for a building is impossible, and final studies assessing the impact of water conservation on demand are not yet complete. The following steps are necessary for the segmented loss method.

- (a) **Preliminary.** Obtain the necessary information regarding the minimum daily static service pressure in the area where the building is to be located. If the building supply is to be metered, obtain information regarding friction loss relative to the rate of flow for meters in the range of sizes to be used. Friction loss data can be obtained from manufacturers of water meters. It is essential that enough pressure be available to overcome all system losses caused by friction and elevation so that plumbing fixtures operate properly. Subsection 604.6 requires the water distribution system to be designed for the minimum pressure available taking into consideration pressure fluctuations. The lowest pressure must be selected to guarantee a continuous, adequate supply of water. The lowest pressure in the public main usually occurs in the summer because of lawn sprinkling and the supply of water needed for air-conditioning cooling towers. Future demands placed on the public main as a result of large growth or expansion should also be considered. The available pressure will decrease as additional loads are placed on the public system.
- (b) **Demand load.** Estimate the supply demand of the building main and the principal branches and risers of the system by totaling the corresponding demand from the applicable part of Table E-103.3(3). When estimating peak demand sizing methods, typically use water supply fixture units (w.s.f.u.) [see Table E-103.3(2)]. This numerical factor measures the load-producing effect of a single plumbing fixture of a given kind. The use of such fixture units can be applied to a single basic probability curve (or table), found in the various sizing methods [see Table E-103.3(3)]. The fixture units are then converted into a gpm flow rate for estimating demand.
1. Estimate continuous supply demand, in gpm, for lawn sprinklers, air conditioners, etc., and add the sum to the total demand for fixtures. The result is the estimated supply demand for the building supply. Fixture units cannot be applied to constant-use fixtures, such as hose bibbs, lawn sprinklers and air conditioners. These types of fixtures must be assigned the gpm value.
- (c) **Selection of pipe size.** This water pipe sizing procedure is based on a system of pressure requirements and losses, the sum of which must not exceed the minimum pressure available at the supply source. These pressures are as follows:
1. Pressure required at the fixture to produce the required flow. (See Subsections 604.3 and 604.5.)
 2. Static pressure loss or gain (because of head) is computed at 0.433 psi per foot of elevation change.
 3. Loss through a water meter. The friction or pressure loss can be obtained from the manufacturer.
 4. Loss through taps in water main [see Table E-103.3(4)].
 5. Losses through special devices, such as filters, softeners, backflow prevention devices and pressure regulators. These values must be obtained from the manufacturer.
 6. Loss through valves and fittings [see Tables E-103.3(5) and E-103.3(6)]. Losses for these items are calculated by converting to an equivalent length of piping and adding to the total pipe length.
 7. Loss caused by pipe friction can be calculated when the pipe size, pipe length and flow through the pipe are known. With these three items, the friction loss can be determined using Figures E-103.3(2) through E-103.3(7). When using charts, use pipe inside diameters. For piping flow charts not included, use the manufacturer's tables and velocity recommendations. Before attempting to size any water supply system, it is necessary to gather preliminary information, which includes available pressure, piping material, select design velocity, elevation differences and developed length, to the most remote fixture. The water supply system is divided into sections at major changes in elevation or where branches lead to fixture groups. The peak demand must be determined in each part of the hot and cold water supply system, which includes the corresponding w.s.f.u. and conversion to a gpm flow rate to be expected through each section. Sizing methods require the determination of the "most hydraulically remote" fixture to compute the pressure loss caused by pipe and fittings. The hydraulically remote fixture represents the most downstream fixture along the circuit of piping requiring the most available pressure to operate properly. Consideration must be given to all pressure demands and losses, such as friction caused by pipe, fittings and equipment, elevation and the residual pressure required by Table 604.3. The two most common and frequent complaints about the water supply system operation are lack of adequate pressure and noise.

Problem. What size Type L copper water pipe, service and distribution will be required to serve a two-story factory building having on each floor, back-to-back, two toilet rooms each equipped with hot and cold water? The highest fixture is 21 feet above the street main, which is tapped with a 2-inch corporation cock at which point the minimum pressure is 55 psi. In the building basement, a 2-inch meter with a maximum pressure drop of 11 psi and a 3-inch reduced pressure principle backflow preventer with a maximum pressure drop of 9 psi are to be installed. The system is shown in Figure E-103.3(1). To be determined are the pipe sizes for the service main, and the cold and hot water distribution pipes.

Solution. A tabular arrangement, such as shown in Table E-103.3(1), should first be constructed. The steps to be followed are indicated by the tabular arrangement itself as they are in sequence, Columns 1 through 10 and Lines A through L.

Step 1.

Columns 1 and 2. Divide the system into sections, breaking at major changes in elevation or where branches lead to fixture groups. After Point B [see Figure E-103.3(1)], separate consideration will be given to the hot and cold water piping. Enter the sections to be considered in the service and cold water piping in Column 1 of the tabular arrangement. Column 1 of Table E-103.3(1) provides a line-by-line, recommended tabular arrangement for use in solving pipe sizing.

The objective in designing the water supply system is to ensure an adequate water supply and pressure to all fixtures and equipment. Column 2 provides the psi to be considered separately from the minimum pressure available at the main. Losses to take into consideration are the following: the differences in elevations between the water supply source and the highest water supply outlet; meter pressure losses; the tap in main loss; special fixture devices, such as water softeners and backflow prevention devices; and the pressure required at the most remote fixture outlet. The difference in elevation can result in an increase or decrease in available pressure at the main. Where the water supply outlet is located above the source, the result is a loss in the available pressure and is subtracted from the pressure at the water source. Where the highest water supply outlet is located below the water supply source, there will be an increase in pressure that is added to the available pressure of the water source.

Column 3. According to Table E-103.3(3), determine the gpm of flow to be expected in each section of the system. These flows range from 28.6 to 108 gpm. Load values for fixtures must be determined as w.s.f.u. and then converted to a gpm rating to determine peak demand. When cal-

culating peak demands, the w.s.f.u. are added and then converted to the gpm rating. For continuous flow fixtures, such as hose bibbs and lawn sprinkler systems, add the gpm demand to the intermittent demand of fixtures. For example, a total of 120 w.s.f.u. is converted to a demand of 48 gpm. Two hose bibbs \times 5 gpm demand = 10 gpm. Total gpm rating = 48.0 gpm + 10 gpm = 58.0 gpm demand.

Step 2.

Line A. Enter the minimum pressure available at the main source of supply in Column 2; this is 55 psi. The local water authorities generally keep records of pressures at different times of the day and year. The available pressure can also be checked from nearby buildings or from fire department hydrant checks.

Line B. Determine from Table 604.3 the highest pressure required for the fixtures on the system, which is 15 psi, to operate a flushometer valve. The most remote fixture outlet is necessary to compute the pressure loss caused by pipe and fittings, and represents the most downstream fixture along the circuit of piping requiring the available pressure to operate properly as indicated by Table 604.3.

Line C. Determine the pressure loss for the meter size given or assumed. The total water flow from the main through the service, as determined in Step 1, will serve to aid in the meter selected. There are three common types of water meters; the pressure losses are determined by the American Water Works Association Standards for displacement type, compound type and turbine type. The maximum pressure loss of such devices takes into consideration the meter size, safe operating capacity (gpm) and maximum rates for continuous operations (gpm). Typically, equipment imparts greater pressure losses than piping.

Line D. Select from Table E-103.3(4) and enter the pressure loss for the tap size given or assumed. The loss of pressure through taps and tees, in psi, are based on the total gpm flow rate and size of the tap.

Line E. Determine the difference in elevation between the main and source of supply, and the highest fixture on the system. Multiply this figure, expressed in feet, by 0.43 psi. Enter the resulting psi loss on Line E. The difference in elevation between the water supply source and the highest water supply outlet has a significant impact on the sizing of the water supply system. The difference in elevation usually results in a loss in the available pressure because the water supply outlet is generally located above the water supply source. The loss is caused by the pressure required to lift the water to the outlet. The pressure loss is subtracted from the pressure at the

water source. Where the highest water supply outlet is located below the water source, there will be an increase in pressure, which is added to the available pressure of the water source.

Lines F, G and H. The pressure losses through filters, backflow prevention devices or other special fixtures must be obtained from the manufacturer, or estimated and entered on these lines. Equipment, such as backflow prevention devices, check valves, water softeners, instantaneous or tankless water heaters, filters and strainers, can impart a much greater pressure loss than the piping. The pressure losses can range from 8 psi to 30 psi.

Step 3.

Line I. The sum of the pressure requirements and losses that affect the overall system (Lines B through H) is entered on this line. Summarizing the steps, all of the system losses are subtracted from the minimum water pressure. The remainder is the pressure available for friction, defined as the energy available to push the water through the pipes to each fixture. This force can be used as an average pressure loss, as long as the pressure available for friction is not exceeded. Saving a certain amount for available water supply pressures as an area incurs growth, or because of the aging of the pipe or equipment added to the system, is recommended.

Step 4.

Line J. Subtract Line I from Line A. This gives the pressure that remains available from overcoming friction losses in the system. This figure is a guide to the pipe size that is chosen for each section, incorporating the total friction losses to the most remote outlet (measured length is called developed length).

Exception: When the main is above the highest fixture, the resulting psi must be considered a pressure gain (static head gain) and omitted from the sums of Lines B through H and added to Line J.

The maximum friction head loss that can be tolerated in the system during peak demand is the difference between the static pressure at the highest and most remote outlet at no-flow conditions and the minimum flow pressure required at that outlet. If the losses are within the required limits, then every run of pipe will also be within the required friction head loss. Static pressure loss is the most remote outlet in feet multiplied by 0.433, which equals the loss in psi caused by elevation differences.

Step 5.

Column 4. Enter the length of each section from the main to the most remote outlet (at Point E). Divide the water supply system into sections

breaking at major changes in elevation or where branches lead to fixture groups.

Step 6.

Column 5. When selecting a trial pipe size, the length from the water service or meter to the most remote fixture outlet must be measured to determine the developed length. However, in systems having a flush valve or temperature-controlled shower at the top most floors of the developed length would be from the water meter to the most remote flush valve on the system. A rule of thumb is that size will become progressively smaller as the system extends farther from the main source of supply. Trial pipe size may be arrived at by the following formula:

Line J. (Pressure available to overcome pipe friction) \times 100/equivalent length of run total developed length to most remote fixture \times percentage factor of 1.5 (Note: a percentage factor is used only as an estimate for friction losses imposed for fittings for initial trial pipe size) = psi (average pressure drops per 100 feet of pipe).

For trial pipe size, see Figure E-103.3(3) (Type L copper) based on 2.77 psi and 108 gpm = 2½ inches. To determine the equivalent length of run to the most remote outlet, the developed length is determined and added to the friction losses for fittings and valves. The developed lengths of the designated pipe sections are as follows:

A-B	54 feet
B-C	8 feet
C-D	13 feet
D-E	150 feet

Total developed length = 225 feet

The equivalent length of the friction loss in fittings and valves must be added to the developed length (most remote outlet). Where the size of fittings and valves is not known, the added friction loss should be approximated. A general rule that has been used is to add 50 percent of the developed length to allow for fittings and valves. For example, the equivalent length of run equals the developed length of run (225 feet \times 1.5 = 338 feet). The total equivalent length of run for determining a trial pipe size is 338 feet.

Example: 9.36 (pressure available to overcome pipe friction) \times 100/338 (equivalent length of run = 225 \times 1.5) = 2.77 psi (average pressure drop per 100 feet of pipe).

Step 7.

Column 6. Select from Table E-103.3(6) the equivalent lengths for the trial pipe size of fittings and valves on each pipe section. Enter the sum

for each section in Column 6. (The number of fittings to be used in this example must be an estimate.) The equivalent length of piping is the developed length plus the equivalent lengths of pipe corresponding to friction head losses for fittings and valves. Where the size of fittings and valves is not known, the added friction head losses must be approximated. An estimate for this example is found in Table E.1.

Step 8.

Column 7. Add the figures from Columns 4 and 6, and enter in Column 7. Express the sum in hundreds of feet.

Step 9.

Column 8. Select from Figure E-103.3(3) the friction loss per 100 feet of pipe for the gpm flow rate in a section (Column 3) and trial pipe size (Column 5). Maximum friction head loss per 100 feet is determined on the basis of the total pressure available for friction head loss and the longest equivalent length of run. The selection is based on the gpm demand, uniform friction head loss and maximum design velocity. Where the size indicated by the hydraulic table indicates a

velocity in excess of the selected velocity, a size must be selected that produces the required velocity.

Step 10.

Column 9. Multiply the figures in Columns 7 and 8 for each section and enter in Column 9.

Total friction loss is determined by multiplying the friction loss per 100 feet for each pipe section in the total developed length by the pressure loss in fittings expressed as equivalent length in feet. Note: Section C-F should be considered in the total pipe friction losses only if greater loss occurs in Section C-F than in pipe in Section D-E. Section C-F is not considered in the total developed length. Total friction loss in equivalent length is determined in Table E.2.

Step 11.

Line K. Enter the sum of the values in Column 9. The value is the total friction loss in equivalent length for each designated pipe section.

Step 12.

Line L. Subtract Line J from Line K and enter in Column 10.

TABLE E.1

COLD WATER PIPE SECTION	FITTINGS/VALVES	PRESSURE LOSS EXPRESSED AS EQUIVALENT LENGTH OF TUBE (feet)	HOT WATER PIPE SECTION	FITTINGS/VALVES	PRESSURE LOSS EXPRESSED AS EQUIVALENT OF TUBE (feet)
A-B	3 – 2½" Gate valves	3	A-B	3 – 2½" Gate valves	3
	1 – 2½" Side branch tee	12		1 – 2½" Side branch tee	12
B-C	1 – 2½" Straight run tee	0.5	B-C	1 – 2" Straight run tee	7
				1 – 2" 90-degree ell	0.5
C-F	1 – 2½" Side branch tee	12	C-F	1 – 1½" Side branch tee	7
C-D	1 – 2½" 90-degree ell	7	C-D	1 – ½" 90-degree ell	4
D-E	1 – 2½" Side branch tee	12	D-E	1 – 1½" Side branch tee	7

TABLE E.2

PIPE SECTIONS	FRICTION LOSS EQUIVALENT LENGTH (feet)	
	Cold Water	Hot Water
A-B	$0.69 \times 3.2 = 2.21$	$0.69 \times 3.2 = 2.21$
B-C	$0.085 \times 3.1 = 0.26$	$0.16 \times 1.4 = 0.22$
C-D	$0.20 \times 1.9 = 0.38$	$0.17 \times 3.2 = 0.54$
D-E	$1.62 \times 1.9 = 3.08$	$1.57 \times 3.2 = 5.02$
Total pipe friction losses (Line K)	5.93	7.99

APPENDIX E—SIZING OF WATER PIPING SYSTEM

The result should always be a positive or plus figure. If it is not, repeat the operation using Columns 5, 6, 8 and 9 until a balance or near balance is obtained. If the difference between Lines J and K is a high positive number, it is an indication that the pipe sizes are too large and should be reduced, thus saving materials. In such a case, the operations using Columns 5, 6, 8 and 9 should again be repeated.

The total friction losses are determined and subtracted from the pressure available to overcome pipe friction for trial pipe size. This number is critical as it provides a guide to whether the pipe size selected is too large and the process should be repeated to obtain an economically designed system.

Answer. The final figures entered in Column 5 become the design pipe size for the respective sections. By repeating this operation a second time using the same sketch, but considering the demand for hot water, it is possible to size the hot water distribution piping. This has been worked up as a part of the overall problem in the tabular arrangement used for sizing the service and water distribution piping. Note that consideration must be given to the pressure losses from the street main to the water heater (Section A-B) in determining the hot water pipe sizes.

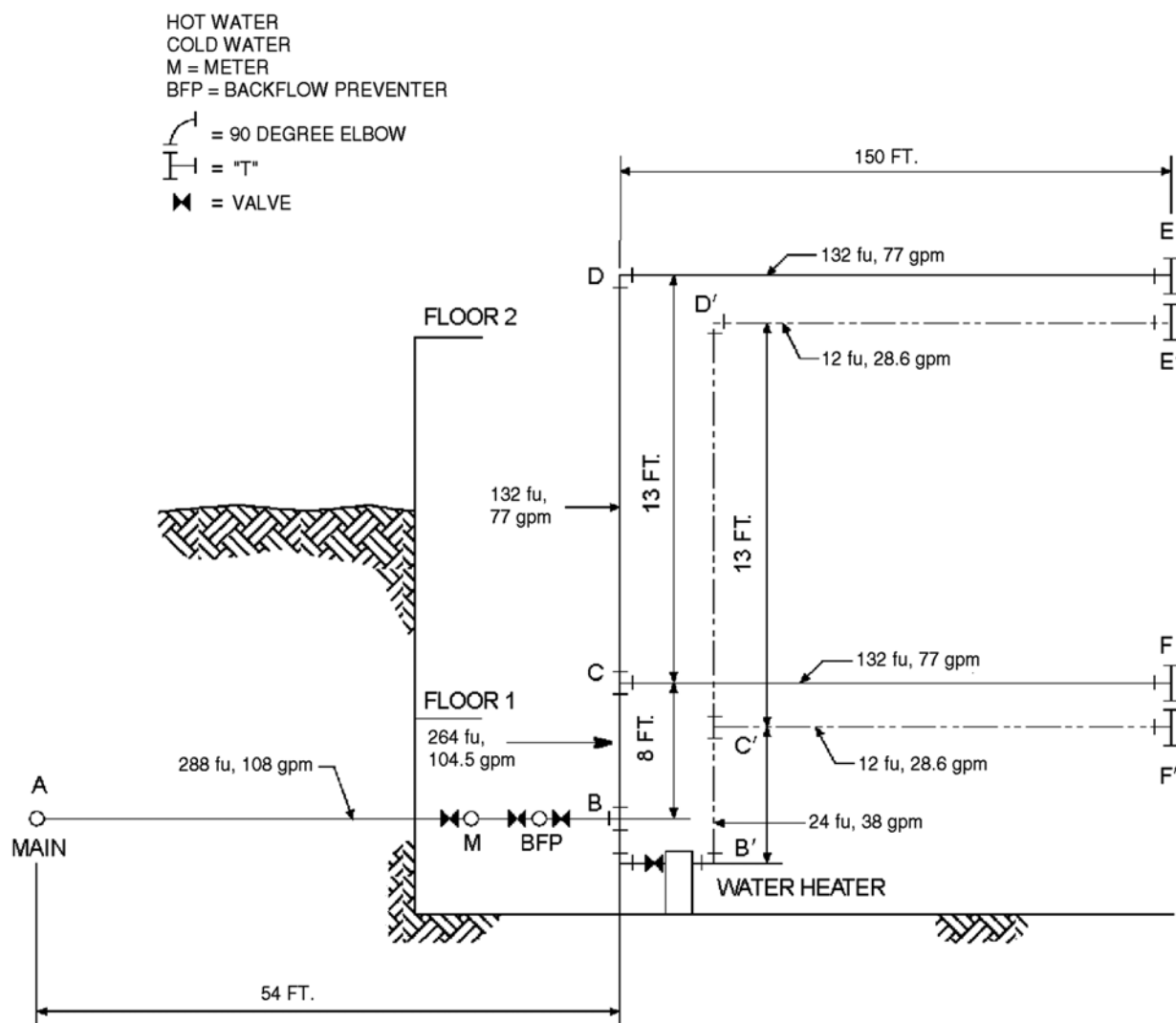


FIGURE E-103.3(1)
EXAMPLE—SIZING

TABLE E-103.3(1)
RECOMMENDED TABULAR ARRANGEMENT FOR USE IN SOLVING PIPE SIZING PROBLEMS

COLUMN	1	2	3	4	5	6	7	8	9	10
Line	Description	Lbs. per square inch (psi)	Gal. per min. through section	Length of section (feet)	Trial pipe size (inches)	Equivalent length of fittings and valves (feet)	Total equivalent length Columns 4 and 6 (100 feet)	Friction loss per 100 feet of trial size pipe (psi)	Friction loss in equivalent length Col. 8 x Col. 7 (psi)	Excess pressure over friction losses (psi)
A	Service	Minimum pressure available at main 55.00								
B	and cold water distribution piping ^a	Highest pressure required at a fixture (see Table 604.3)..... 15.00								
C		Meter loss 2-inch meter..... 11.00								
D		Tap in main loss 2-inch tap [see Table E-103.3(4)] 1.61								
E		Static head loss 21 × 0.43 psi..... 9.03								
F		Special fixture loss backflow preventer..... 9.00								
G		Special fixture loss—Filter 0.00								
H		Special fixture loss—Other..... 0.00								
I		Total overall losses and requirements (sum of Lines B through H) 45.64								
J		Pressure available to overcome pipe friction (Line A minus Lines B to H)..... 9.36								
	DESIGNATION	FU								
	Pipe section (from diagram)	A-B 288	108.0	54	2 1/2	15.00	0.69	3.2	2.21	—
	Cold water distribution piping	B-C 264	104.0	8	2 1/2	0.5	0.85	3.1	0.26	—
		C-D 132	77.0	13	2 1/2	7.00	0.20	1.9	0.38	—
		C-F ^b 132	77.0	150	2 1/2	12.00	1.62	1.9	3.08	—
		D-E ^b 132	77.0	150	2 1/2	12.00	1.62	1.9	3.08	—
K	Total pipe friction losses (cold)	—	—	—	—	—	—	—	5.93	—
L	Difference (Line J minus Line K)	—	—	—	—	—	—	—	—	3.43
	Pipe section (from diagram)	A'B' 288	108.0	54	2 1/2	12.00	0.69	3.3	2.21	—
	Diagram	B'C' 24	38.0	8	2	7.5	0.16	1.4	0.22	—
	Hot water	C'D' 12	28.6	13	1 1/2	4.0	0.17	3.2	0.54	—
	Distribution	C-F ^b 12	28.6	150	1 1/2	7.00	1.57	3.2	5.02	—
	Piping	C-F ^b 12	28.6	150	1 1/2	7.00	1.57	3.2	5.02	—
K	Total pipe friction losses (hot)	—	—	—	—	—	—	—	7.99	—
L	Difference (Line J minus Line K)	—	—	—	—	—	—	—	—	1.37

a. To be considered as pressure gain for fixtures below main (to consider separately, omit from “I” and add to “J”).

b. To consider separately, in Line K, use C-F only if a greater loss than Note a.

TABLE E-103.3(2)
LOAD VALUES ASSIGNED TO FIXTURES^a

FIXTURE	OCCUPANCY	TYPE OF SUPPLY CONTROL	LOAD VALUES, IN WATER SUPPLY FIXTURE UNITS (w.s.f.u.)		
			Cold	Hot	Total
Bathroom group	Private	Flush tank	2.7	1.5	3.6
Bathroom group	Private	Flush valve	6.0	3.0	8.0
Bathtub	Private	Faucet	1.0	1.0	1.4
Bathtub	Public	Faucet	3.0	3.0	4.0
Bidet	Private	Faucet	1.5	1.5	2.0
Combination fixture	Private	Faucet	2.25	2.25	3.0
Dishwashing machine	Private	Automatic	—	1.4	1.4
Drinking fountain	Offices, etc.	$\frac{3}{8}$ -inch valve	0.25	—	0.25
Kitchen sink	Private	Faucet	1.0	1.0	1.4
Kitchen sink	Hotel, restaurant	Faucet	3.0	3.0	4.0
Laundry trays (1 to 3)	Private	Faucet	1.0	1.0	1.4
Lavatory	Private	Faucet	0.5	0.5	0.7
Lavatory	Public	Faucet	1.5	1.5	2.0
Service sink	Offices, etc.	Faucet	2.25	2.25	3.0
Shower head	Public	Mixing valve	3.0	3.0	4.0
Shower head	Private	Mixing valve	1.0	—	10.0
Urinal	Public	1-inch flush valve	10.0	—	10.0
Urinal	Public	$\frac{3}{4}$ -inch flush valve	5.0	—	5.0
Urinal	Public	Flush tank	3.0	—	3.0
Washing machine (8 pounds)	Private	Automatic	1.0	1.0	1.4
Washing machine (8 pounds)	Public	Automatic	2.25	2.25	3.0
Washing machine (15 pounds)	Public	Automatic	3.0	3.0	4.0
Water closet	Private	Flush valve	6.0	—	6.0
Water closet	Private	Flush tank	2.2	—	2.2
Water closet	Public	Flush valve	10.0	—	10.0
Water closet	Public	Flush tank	5.0	—	5.0
Water closet	Public or private	Flushometer tank	2.0	—	2.0

a. For fixtures not listed, loads should be assumed by comparing the fixture to one listed using water in similar quantities and at similar rates. The assigned loads for fixtures with both hot and cold water supplies are given for separate hot and cold water loads, and for the total load. The separate hot and cold water loads being three-fourths of the total load for the fixture in each case.

TABLE E-103.3(3)
TABLE FOR ESTIMATING DEMAND

SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSH TANKS			SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSH VALVES		
Load	Demand		Load	Demand	
(w.s.f.u.)	(gpm)	(cfm)	(w.s.f.u.)	(gpm)	(cfm)
1	3.0	0.04104	—	—	—
2	5.0	0.0684	—	—	—
3	6.5	0.86892	—	—	—
4	8.0	1.06944	—	—	—
5	9.4	1.256592	5	15.0	2.0052
6	10.7	1.430376	6	17.4	2.326032
7	11.8	1.577424	7	19.8	2.646364
8	12.8	1.711104	8	22.2	2.967696
9	13.7	1.831416	9	24.6	3.288528
10	14.6	1.951728	10	27.0	3.60936
11	15.4	2.058672	11	27.8	3.716304
12	16.0	2.13888	12	28.6	3.823248
13	16.5	2.20572	13	29.4	3.930192
14	17.0	2.27256	14	30.2	4.037136
15	17.5	2.3394	15	31.0	4.14408
16	18.0	2.90624	16	31.8	4.241024
17	18.4	2.459712	17	32.6	4.357968
18	18.8	2.513184	18	33.4	4.464912
19	19.2	2.566656	19	34.2	4.571856
20	19.6	2.620128	20	35.0	4.6788
25	21.5	2.87412	25	38.0	5.07984
30	23.3	3.114744	30	42.0	5.61356
35	24.9	3.328632	35	44.0	5.88192
40	26.3	3.515784	40	46.0	6.14928
45	27.7	3.702936	45	48.0	6.41664
50	29.1	3.890088	50	50.0	6.684
60	32.0	4.27776	60	54.0	7.21872
70	35.0	4.6788	70	58.0	7.75344
80	38.0	5.07984	80	61.2	8.181216
90	41.0	5.48088	90	64.3	8.595624
100	43.5	5.81508	100	67.5	9.0234
120	48.0	6.41664	120	73.0	9.75864
140	52.5	7.0182	140	77.0	10.29336
160	57.0	7.61976	160	81.0	10.82808
180	61.0	8.15448	180	85.5	11.42964
200	65.0	8.6892	200	90.0	12.0312
225	70.0	9.3576	225	95.5	12.76644
250	75.0	10.026	250	101.0	13.50168
275	80.0	10.6944	275	104.5	13.96956
300	85.0	11.3628	300	108.0	14.43744
400	105.0	14.0364	400	127.0	16.97736
500	124.0	16.57632	500	143.0	19.11624
750	170.0	22.7256	750	177.0	23.66136
1,000	208.0	27.80544	1,000	208.0	27.80544
1,250	239.0	31.94952	1,250	239.0	31.94952
1,500	269.0	35.95992	1,500	269.0	35.95992
1,750	297.0	39.70296	1,750	297.0	39.70296
2,000	325.0	43.446	2,000	325.0	43.446
2,500	380.0	50.7984	2,500	380.0	50.7984
3,000	433.0	57.88344	3,000	433.0	57.88344
4,000	535.0	70.182	4,000	525.0	70.182
5,000	593.0	79.27224	5,000	593.0	79.27224

TABLE E-103.3(4)
LOSS OF PRESSURE THROUGH TAPS AND TEES IN POUNDS PER SQUARE INCH (psi)

GALLONS PER MINUTE	SIZE OF TAP OR TEE (inches)						
	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	3
10	1.35	0.64	0.18	0.08	—	—	—
20	5.38	2.54	0.77	0.31	0.14	—	—
30	12.10	5.72	1.62	0.69	0.33	0.10	—
40	—	10.20	3.07	1.23	0.58	0.18	—
50	—	15.90	4.49	1.92	0.91	0.28	—
60	—	—	6.46	2.76	1.31	0.40	—
70	—	—	8.79	3.76	1.78	0.55	0.10
80	—	—	11.50	4.90	2.32	0.72	0.13
90	—	—	14.50	6.21	2.94	0.91	0.16
100	—	—	17.94	7.67	3.63	1.12	0.21
120	—	—	25.80	11.00	5.23	1.61	0.30
140	—	—	35.20	15.00	7.12	2.20	0.41
150	—	—	—	17.20	8.16	2.52	0.47
160	—	—	—	19.60	9.30	2.92	0.54
180	—	—	—	24.80	11.80	3.62	0.68
200	—	—	—	30.70	14.50	4.48	0.84
225	—	—	—	38.80	18.40	5.60	1.06
250	—	—	—	47.90	22.70	7.00	1.31
275	—	—	—	—	27.40	7.70	1.59
300	—	—	—	—	32.60	10.10	1.88

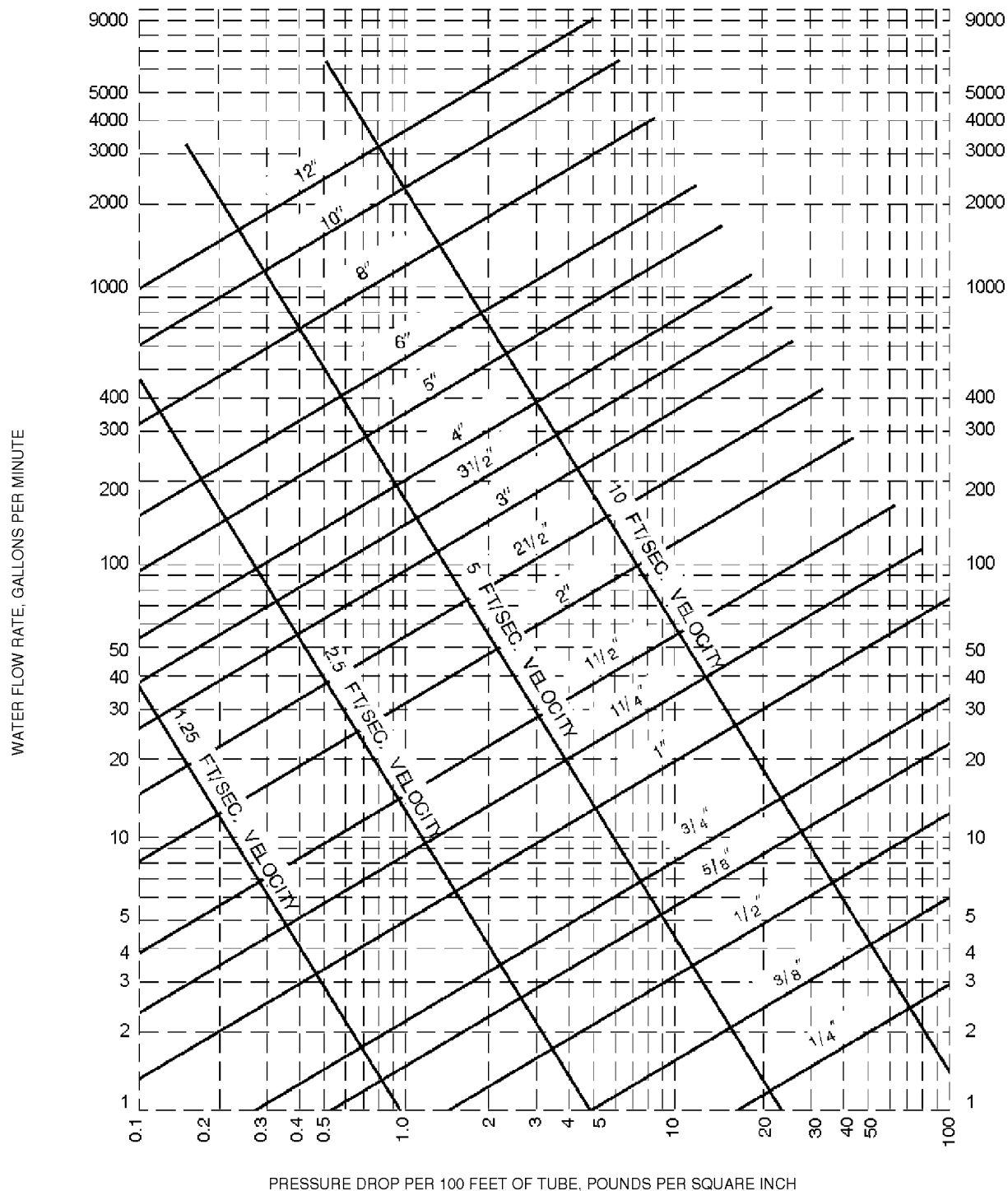
TABLE E-103.3(5)
ALLOWANCE IN EQUIVALENT LENGTHS OF PIPE FOR FRICTION LOSS IN VALVES AND THREADED FITTINGS (feet)

FITTING OR VALVE	PIPE SIZE (inches)							
	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
45-degree elbow	1.2	1.5	1.8	2.4	3.0	4.0	5.0	6.0
90-degree elbow	2.0	2.5	3.0	4.0	5.0	7.0	8.0	10.0
Tee, run	0.6	0.8	0.9	1.2	1.5	2.0	2.5	3.0
Tee, branch	3.0	4.0	5.0	6.0	7.0	10.0	12.0	15.0
Gate valve	0.4	0.5	0.6	0.8	1.0	1.3	1.6	2.0
Balancing valve	0.8	1.1	1.5	1.9	2.2	3.0	3.7	4.5
Plug-type cock	0.8	1.1	1.5	1.9	2.2	3.0	3.7	4.5
Check valve, swing	5.6	8.4	11.2	14.0	16.8	22.4	28.0	33.6
Globe valve	15.0	20.0	25.0	35.0	45.0	55.0	65.0	80.0
Angle valve	8.0	12.0	15.0	18.0	22.0	28.0	34.0	40.0

TABLE E-103.3(6)
PRESSURE LOSS IN FITTINGS AND VALVES EXPRESSED AS EQUIVALENT LENGTH OF TUBE^a (feet)

NOMINAL OR STANDARD SIZE (inches)	FITTINGS				Coupling	VALVE			
	Standard Ell		90-Degree Tee			Ball	Gate	Butterfly	Check
	90 Degrees	45 Degrees	Side Branch	Straight Run					
³ / ₈	0.5	—	1.5	—	—	—	—	—	1.5
¹ / ₂	1	0.5	2	—	—	—	—	—	2
⁵ / ₈	1.5	0.5	2	—	—	—	—	—	2.5
³ / ₄	2	0.5	3	—	—	—	—	—	3
1	2.5	1	4.5	—	—	0.5	—	—	4.5
1 ¹ / ₄	3	1	5.5	0.5	0.5	0.5	—	—	5.5
1 ¹ / ₂	4	1.5	7	0.5	0.5	0.5	—	—	6.5
2	5.5	2	9	0.5	0.5	0.5	0.5	7.5	9
2 ¹ / ₂	7	2.5	12	0.5	0.5	—	1	10	11.5
3	9	3.5	15	1	1	—	1.5	15.5	14.5
3 ¹ / ₂	9	3.5	14	1	1	—	2	—	12.5
4	12.5	5	21	1	1	—	2	16	18.5
5	16	6	27	1.5	1.5	—	3	11.5	23.5
6	19	7	34	2	2	—	3.5	13.5	26.5
8	29	11	50	3	3	—	5	12.5	39

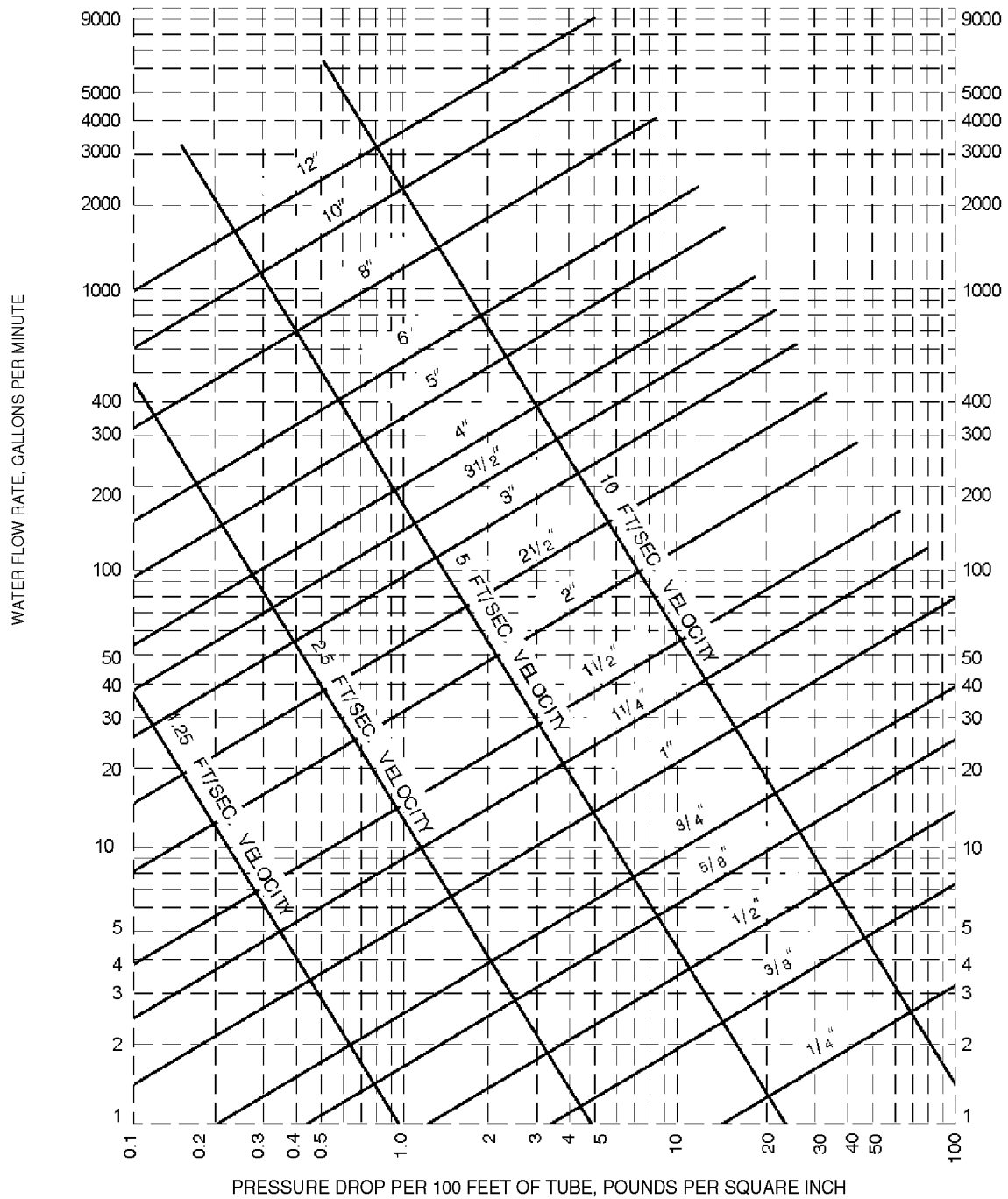
- a. Allowances are for streamlined soldered fittings and recessed threaded fittings. For threaded fittings, double the allowances shown in this Table. The equivalent lengths presented in this Table are based on a C factor of 150 in the Hazen-Williams friction loss formula. The lengths shown are rounded to the nearest half-foot.



Note: Fluid velocities in excess of 5 to 8 feet/second are not usually recommended.

a. This Figure applies to smooth new copper tubing with recessed (Streamline) soldered joints and to the actual sizes of types indicated on the diagram.

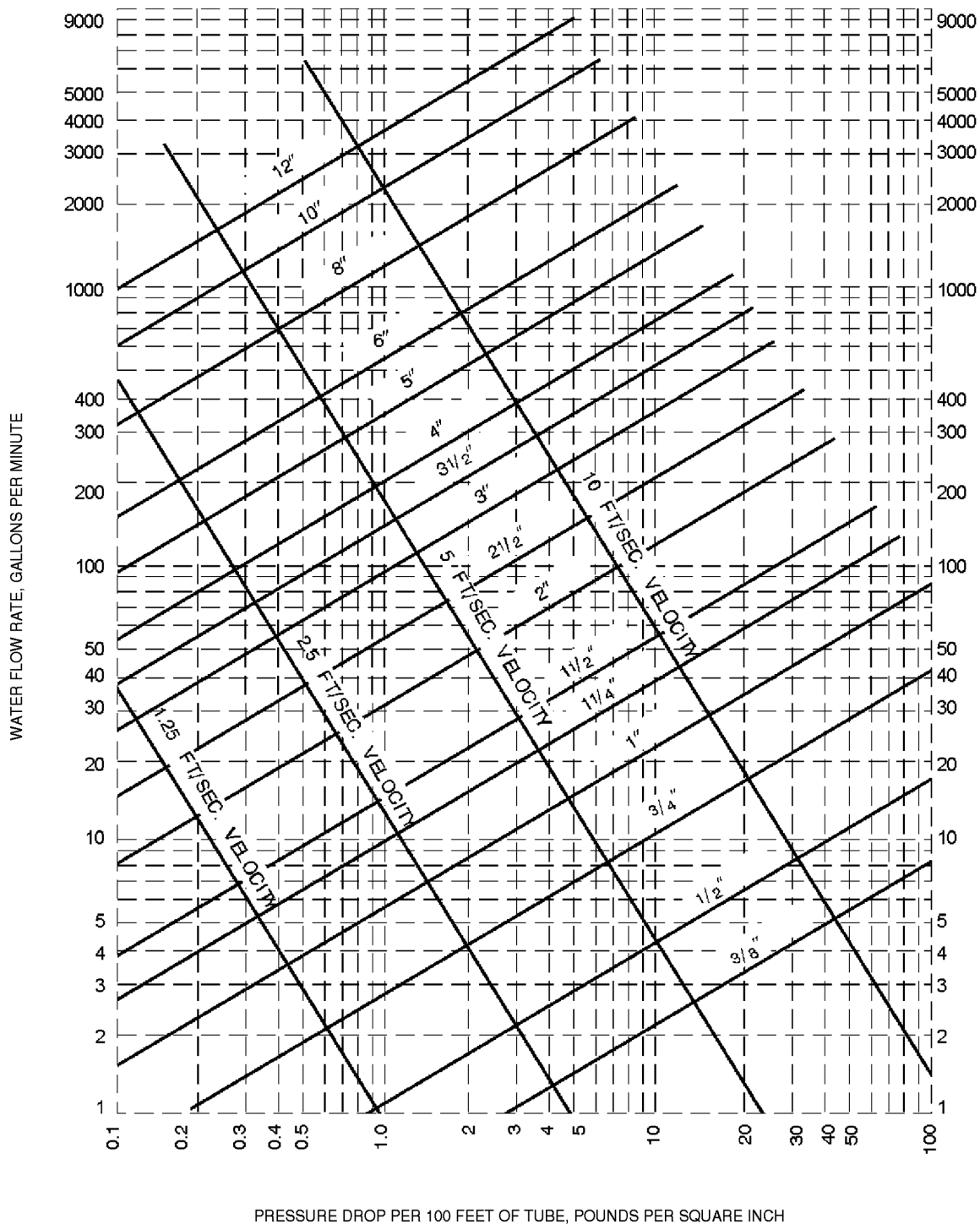
FIGURE E-103.3(2)
FRICTION LOSS IN SMOOTH PIPE^a
(TYPE K, ASTM B88 COPPER TUBING)



Note: Fluid velocities in excess of 5 to 8 feet/second are not usually recommended.

a. This Figure applies to smooth new copper tubing with recessed (streamline) soldered joints and to the actual sizes of types indicated on the diagram.

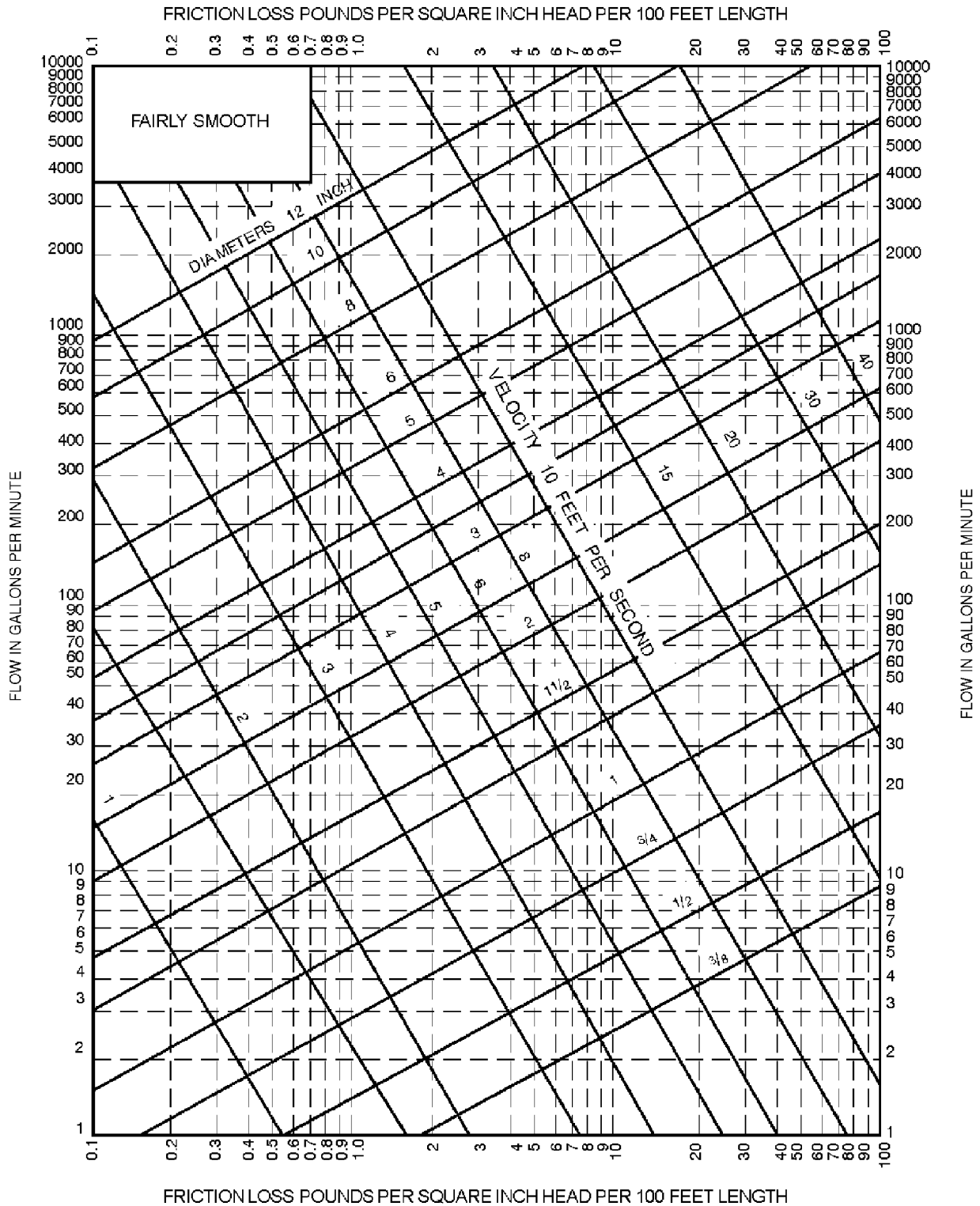
FIGURE E-103.3(3)
FRICTION LOSS IN SMOOTH PIPE^a
(TYPE L, ASTM B88 COPPER TUBING)



Note: Fluid velocities in excess of 5 to 8 feet/second are not usually recommended.

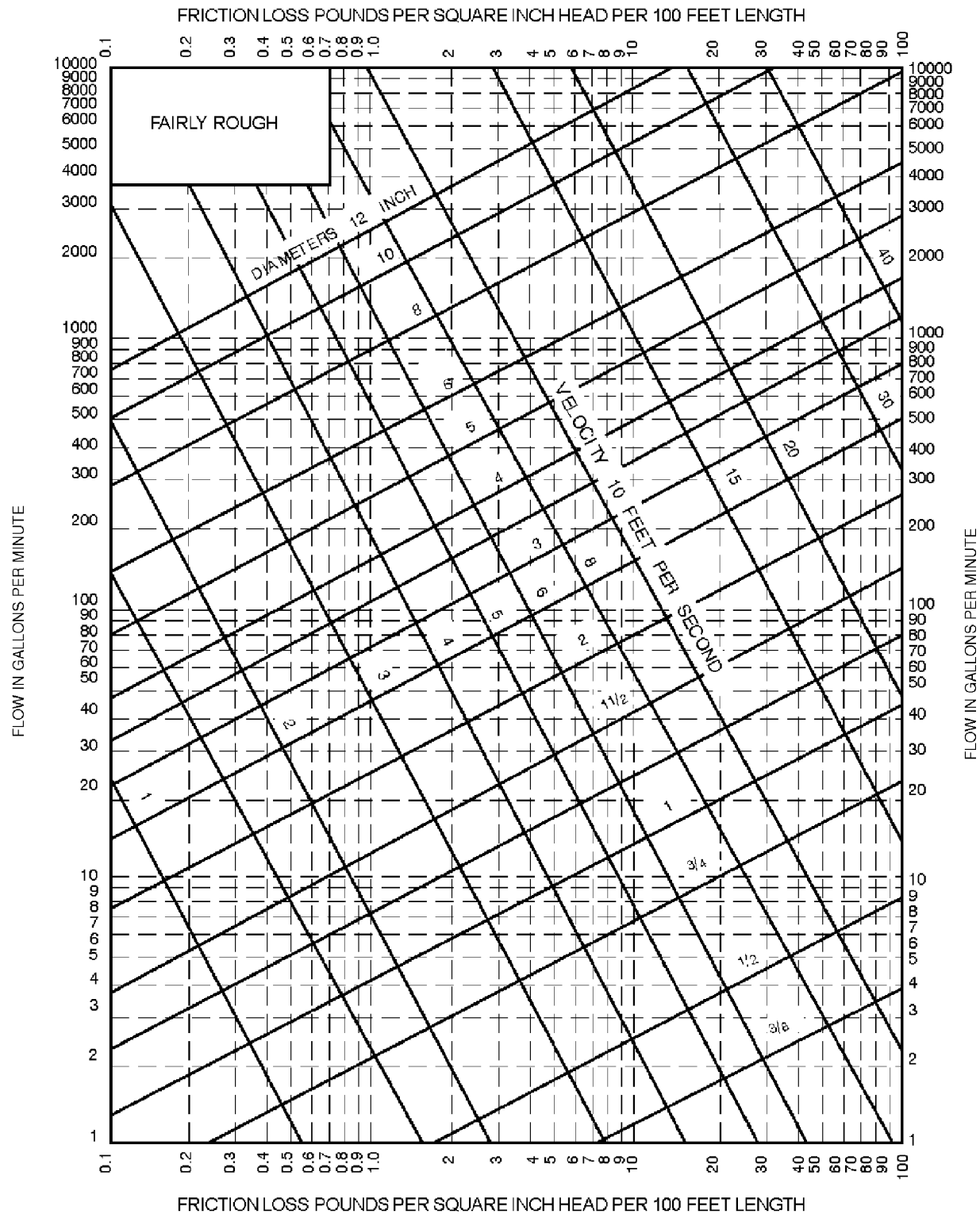
a. This Figure applies to smooth new copper tubing with recessed (streamline) soldered joints and to actual sizes of types indicated on the diagram.

FIGURE E-103.3(4)
FRICTION LOSS IN SMOOTH PIPE^a
(TYPE M, ASTM B88 COPPER TUBING)



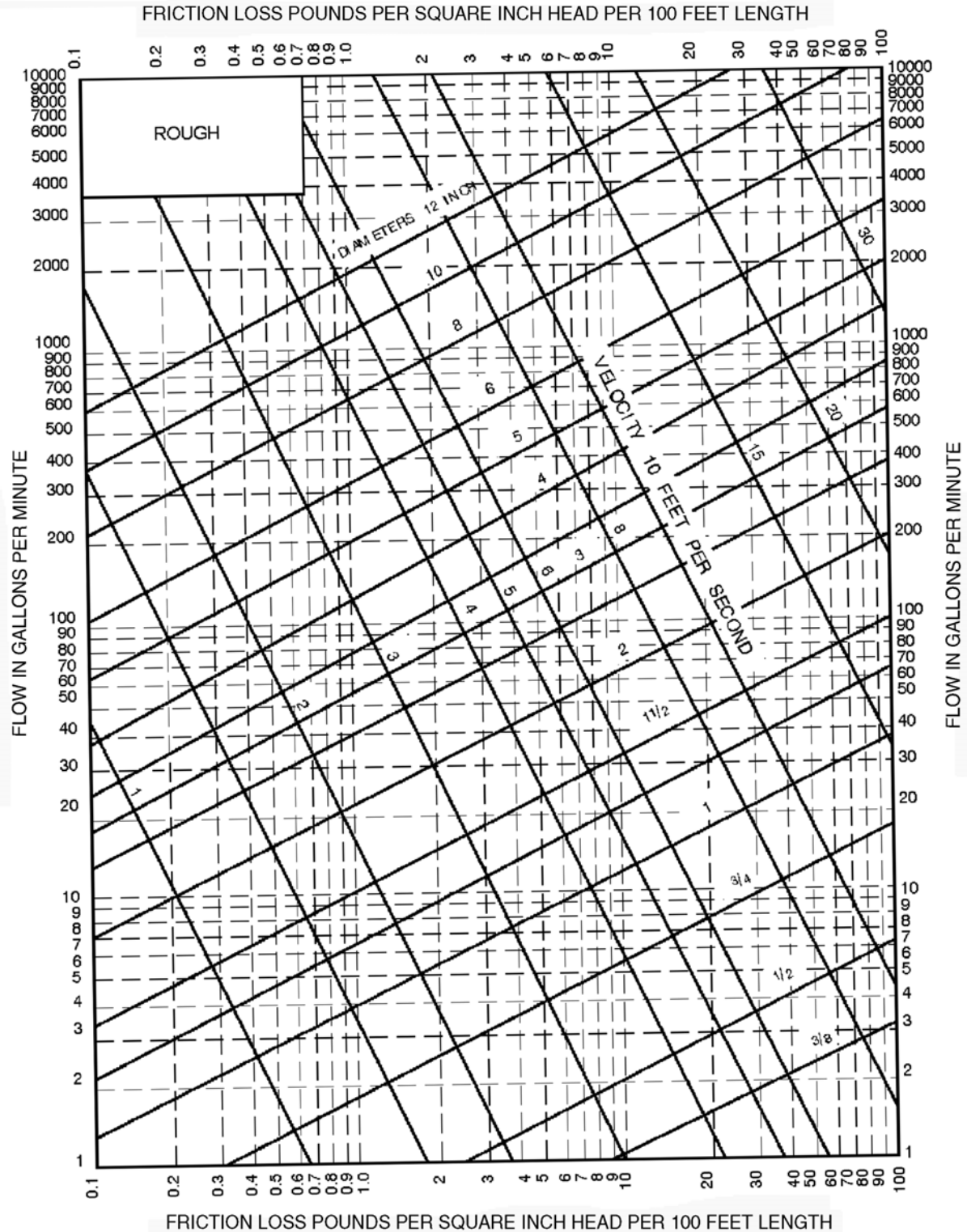
a. This Figure applies to smooth new steel (fairly smooth) pipe and to actual diameters of standard-weight pipe.

FIGURE E-103.3(5)
FRICTION LOSS IN FAIRLY SMOOTH PIPE^a



a. This Figure applies to fairly rough pipe and to actual diameters that, in general, will be less than the actual diameters of the new pipe of the same kind.

FIGURE E-103.3(6)
FRICTION LOSS IN FAIRLY ROUGH PIPE^a



a. This Figure applies to very rough pipe and existing pipe, and to their actual diameters.

FIGURE E-103.3(7)
FRICTION LOSS IN FAIRLY ROUGH PIPE^a

SECTION E-201

SELECTION OF PIPE SIZE—METHOD 2

E-201.1 Size of water-service mains, branch mains and risers. The minimum size water service pipe shall be $\frac{3}{4}$ inch. The size of water-service mains, branch mains and risers shall be determined according to the water supply demand (gpm), available water pressure (psi), and friction loss due to the water meter and developed length of pipe (feet), including the equivalent length of fittings. The size of each water distribution system shall be determined according to the procedure outlined in this Section or by other design methods conforming to acceptable engineering practice and approved by the Chief Plumbing Official:

- (a) Supply load in the building water distribution system shall be determined by the total load on the pipe being sized, in terms of w.s.f.u., as shown in Table E-103.3(2). For fixtures not listed, choose a w.s.f.u. value of a fixture with similar flow characteristics.
- (b) Obtain the minimum daily static service pressure (psi) available (as determined by the local water authority) at the water meter or other source of supply at the installation location. Adjust this minimum daily static pressure (psi) for the following conditions:
 1. Determine the difference in elevation between the source of supply and the highest water supply outlet. Where the highest water supply outlet is located above the source of supply, deduct 0.5 psi for each 1 foot of difference in elevation. Where the highest water supply outlet is located below the source of supply, add 0.5 psi for each 1 foot of difference in elevation.
 2. Where a water pressure-reducing valve is installed in the water distribution system, the minimum daily static water pressure available is 80 percent of the minimum daily static water pressure at the source of supply or the set pressure downstream of the water pressure-reducing valve, whichever is smaller.
 3. Deduct all pressure losses due to special equipment, such as a backflow preventer, water filter and water softener. Pressure loss data for each piece of equipment shall be obtained through the manufacturer of such devices.
 4. Deduct the pressure in excess of 8 psi due to the installation of a special plumbing fixture, such as a temperature-controlled shower and flushometer tank water closet. Using the resulting minimum available pressure, find the corresponding pressure range in Table E-201.1.
- (c) The maximum developed length for water piping is the actual length of pipe between the source of the supply and the most remote fixture, including either hot (through the water heater) or cold water branches, mul-

tiplied by a factor of 1.2 to compensate for pressure loss through fittings. Select the appropriate column in Table E-201.1 equal to or greater than the calculated maximum developed length.

- (d) To determine the size of water service pipe, meter and main distribution pipe to the building using the appropriate table, follow the selected “maximum developed length” column to a fixture unit equal to or greater than the total installation demand calculated by using the “combined” w.s.f.u. column of Table E-103.3(2). Read the water service pipe and meter sizes in the first left-hand column and the main distribution pipe to the building in the second left-hand column on the same row.
- (e) To determine the size of each water distribution pipe, start at the most remote outlet on each branch (either hot or cold branch) and, working back toward the main distribution pipe to the building, add up the w.s.f.u. demand passing through each segment of the distribution system using the related hot or cold column of Table E-103.3(2). Knowing the demand, the size of each segment shall be read from the second left-hand column of the same table and maximum developed length column selected in Steps 1 and 2, under the same or next smaller size meter row. In no case does the size of any branch or main need to be larger than the size of the main distribution pipe to the building established in Step 4.

TABLE E-201.1
MINIMUM SIZE OF WATER METERS, MAINS AND DISTRIBUTION PIPING BASED ON WATER SUPPLY FIXTURE UNIT VALUES (w.s.f.u.)

METER AND SERVICE PIPE (inches)	DISTRIBUTION PIPE (inches)	MAXIMUM DEVELOPMENT LENGTH (feet)									
Pressure Range 30 to 39 psi		40	60	80	100	150	200	250	300	400	500
³ / ₄	¹ / ₂ ^a	2.5	2	1.5	1.5	1	1	0.5	0.5	0	0
³ / ₄	³ / ₄	9.5	7.5	6	5.5	4	3.5	3	2.5	2	1.5
³ / ₄	1	32	25	20	16.5	11	9	7.8	6.5	5.5	4.5
1	1	32	32	27	21	13.5	10	8	7	5.5	5
³ / ₄	1 ¹ / ₄	32	32	32	32	30	24	20	17	13	10.5
1	1 ¹ / ₄	80	80	70	61	45	34	27	22	16	12
1 ¹ / ₂	1 ¹ / ₄	80	80	80	75	54	40	31	25	17.5	13
1	1 ¹ / ₂	87	87	87	87	84	73	64	56	45	36
1 ¹ / ₂	1 ¹ / ₂	151	151	151	151	117	92	79	69	54	43
2	1 ¹ / ₂	151	151	151	151	128	99	83	72	56	45
1	2	87	87	87	87	87	87	87	87	87	86
1 ¹ / ₂	2	275	275	275	275	258	223	196	174	144	122
2	2	365	365	365	365	318	266	229	201	160	134
2	2 ¹ / ₂	533	533	533	533	533	495	448	409	353	311

METER AND SERVICE PIPE (inches)	DISTRIBUTION PIPE (inches)	MAXIMUM DEVELOPMENT LENGTH (feet)									
Pressure Range 40 to 49 psi		40	60	80	100	150	200	250	300	400	500
¾	½ ^a	3	2.5	2	1.5	1.5	1	1	0.5	0.5	0.5
¾	¾	9.5	9.5	8.5	7	5.5	4.5	3.5	3	2.5	2
¾	1	32	32	32	26	18	13.5	10.5	9	7.5	6
1	1	32	32	32	32	21	15	11.5	9.5	7.5	6.5
¾	1¼	32	32	32	32	32	32	32	27	21	16.5
1	1¼	80	80	80	80	65	52	42	35	26	20
1½	1¼	80	80	80	80	75	59	48	39	28	21
1	1½	87	87	87	87	87	87	87	78	65	55
1½	1½	151	151	151	151	151	130	109	93	75	63
2	1½	151	151	151	151	151	139	115	98	77	64
1	2	87	87	87	87	87	87	87	87	87	87
1½	2	275	275	275	275	275	275	264	238	198	169
2	2	365	365	365	365	365	349	304	270	220	185
2	2½	533	533	533	533	533	533	533	528	456	403

(continued)

APPENDIX E—SIZING OF WATER PIPING SYSTEM

TABLE E-201.1—continued
MINIMUM SIZE OF WATER METERS, MAINS AND DISTRIBUTION PIPING BASED ON WATER SUPPLY FIXTURE UNIT VALUES (w.s.f.u.)

METER AND SERVICE PIPE (inches)	DISTRIBUTION PIPE (inches)	MAXIMUM DEVELOPMENT LENGTH (feet)									
		40	60	80	100	150	200	250	300	400	500
Pressure Range 50 to 60 psi											
3/4	1/2 ^a	3	3	2.5	2	1.5	1	1	1	0.5	0.5
3/4	3/4	9.5	9.5	9.5	8.5	6.5	5	4.5	4	3	2.5
3/4	1	32	32	32	32	25	18.5	14.5	12	9.5	8
1	1	32	32	32	32	30	22	16.5	13	10	8
3/4	1 1/4	32	32	32	32	32	32	32	32	29	24
1	1 1/4	80	80	80	80	80	68	57	48	35	28
1 1/2	1 1/4	80	80	80	80	80	75	63	53	39	29
1	1 1/2	87	87	87	87	87	87	87	87	82	70
1 1/2	1 1/2	151	151	151	151	151	151	139	120	94	79
2	1 1/2	151	151	151	151	151	151	146	126	97	81
1	2	87	87	87	87	87	87	87	87	87	87
1 1/2	2	275	275	275	275	275	275	275	275	247	213
2	2	365	365	365	365	365	365	365	329	272	232
2	2 1/2	533	533	533	533	533	533	533	533	533	486

METER AND SERVICE PIPE (inches)	DISTRIBUTION PIPE (inches)	MAXIMUM DEVELOPMENT LENGTH (feet)									
Pressure Range Over 60		40	60	80	100	150	200	250	300	400	500
³ / ₄	¹ / ₂ ^a	3	3	3	2.5	2	1.5	1.5	1	1	0.5
³ / ₄	³ / ₄	9.5	9.5	9.5	9.5	7.5	6	5	4.5	3.5	3
³ / ₄	1	32	32	32	32	32	24	19.5	15.5	11.5	9.5
1	1	32	32	32	32	32	28	28	17	12	9.5
³ / ₄	1 ¹ / ₄	32	32	32	32	32	32	32	32	32	30
1	1 ¹ / ₄	80	80	80	80	80	80	69	60	46	36
1 ¹ / ₂	1 ¹ / ₄	80	80	80	80	80	80	76	65	50	38
1	1 ¹ / ₂	87	87	87	87	87	87	87	87	87	84
1 ¹ / ₂	1 ¹ / ₂	151	151	151	151	151	151	151	144	114	94
2	1 ¹ / ₂	151	151	151	151	151	151	151	151	118	97
1	2	87	87	87	87	87	87	87	87	87	87
1 ¹ / ₂	2	275	275	275	275	275	275	275	275	275	252
2	2	365	368	368	368	368	368	368	368	318	273
2	2 ¹ / ₂	533	533	533	533	533	533	533	533	533	533

a. Minimum size for building supply is $\frac{3}{4}$ -inch pipe.

APPENDIX F

STRUCTURAL SAFETY

SECTION F-101 GENERAL INFORMATION

F-101.1 Notches and holes in joists. Notches in the ends of wood joists and rafters shall not exceed one-fourth the depth. Holes shall not be within 2 inches of the top or bottom of the joist or rafter, and the diameter of any such hole shall not exceed one-third of the depth of the joist or rafter. Notches in the top or bottom of joists or rafters shall not exceed one-sixth of the depth and shall not be located in the middle one-third of the span.

F-101.2 Cutting and notching studs. In exterior walls and bearing partitions, a wood stud shall not be cut or notched to a depth exceeding 25 percent of its width. Cutting or notching of studs to a depth greater than 40 percent of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

F-101.3 Holes in studs. Holes in wood studs shall not be greater in diameter than 40 percent of the stud width. Bored holes not greater than 60 percent of the width of the stud are permitted in nonbearing partitions or in any wall where each bored stud is doubled, provided not more than two such successive double studs are so bored. In no case shall the edge of the bored hole be nearer than $\frac{5}{8}$ inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

APPENDIX G

PRIVATE SEWAGE DISPOSAL

Note: This Appendix is not applicable where other regulations prevail.

SECTION G-101 GENERAL

G-101.1 Sewer connection.

G-101.1.1 Private sewage disposal. Where permitted by Subsection 701.2, and where approved by the Chief Plumbing Inspector, the building sewer may be connected to a private sewage disposal system complying with the provisions of this Appendix. The type of system shall be determined on the basis of location, soil porosity and ground water level, and shall be designed to receive all sanitary sewage from the property. The system, except as otherwise provided, shall consist of a septic tank with effluent discharging into a subsurface disposal field, into one or more seepage pits, or into a combination of subsurface disposal field and seepage pits. Some minimum location dimensions are shown in Table G-101.

G-101.1.2 Special conditions. Where conditions are such that the previously described system cannot be expected to function satisfactorily for commercial, agricultural and industrial plumbing systems; for installations where appreciable amounts of industrial or indigestible waste are produced; for hotels, hospitals, office buildings, schools and other occupancies not listed in Table G-102B; for occupancies producing abnormal quantities of sewage or liquid waste; or when grease interceptors are required by this Code, the method of sewage treatment and disposal shall be first

approved by the Chief Plumbing Inspector. Special sewage disposal systems, or minor, limited or temporary uses, shall be first approved by the Chief Plumbing Inspector.

G-101.2 System design.

G-101.2.1 Soil formation. Disposal systems shall be designed to utilize the most porous or absorptive portions of the soil formation. Where the ground water level extends to within 12 feet or less of the ground surface, or where the upper soil is porous and the underlying stratum is rock or impervious soil, a septic tank and disposal field system shall be installed.

G-101.2.2 Additional requirements. All private sewage disposal systems shall be so designed that additional seepage pits or subsurface drain fields, equivalent to at least 100 percent of the required original system may be installed if the original system cannot absorb all the sewage. No division of the lot or erection of structures on the lot shall be made if such division or structure impairs the usefulness of the 100-percent expansion room for its intended purpose.

G-101.2.3 Limitations. No property shall be improved in excess of its capacity to properly absorb sewage effluent in the quantities and by the means provided in this Appendix.

G101.2.4 Permits refused. When there is insufficient lot area or improper soil conditions for adequate sewage dis-

TABLE G-101
LOCATION OF SEWAGE DISPOSAL SYSTEM
[Minimum Horizontal Clear Dimension^{b, d} (feet)]

DISTANCE FROM	BUILDING SEWER	SEPTIC TANK	DISPOSAL FIELD	SEEPAGE PIT OR CESSPOOL
Buildings or structures ^a	2	5	8	8
Property line adjoining private property	Clear	5	5	8
Water supply wells	50	50	100	150
Streams	50	50	50	100
Large trees	—	10	—	10
Seepage pits or cesspools	—	5	5	12
Disposal field	—	5	4 ^c	5
Domestic water line	1	5	5	5
Distribution box	—	—	5	5

- a. Including porches and steps, whether covered or uncovered; breezeways; roofed porte-cocheres; roofed patios; carports; covered walks; covered driveways; and similar structures or appurtenances.
- b. All nonmetallic drainage piping shall clear domestic water supply wells by at least 50 feet. This distance may be reduced to not less than 25 feet when approved-type metallic piping is installed. Where special hazards are involved, the distance required shall be increased, as may be directed by the Chief Plumbing Inspector.
- c. Plus 2 feet for each additional foot of depth in excess of 1 foot below the bottom of the drain line. (See also Section G-106.)
- d. When disposal fields and/or seepage pits are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be 15 feet.

posal for the building or land use proposed, and the Building Official so finds, no building permit shall be issued and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data and test reports, satisfactory to the Building Official, have been submitted and approved.

G-101.3 Higher requirements. Nothing contained in this Appendix shall be construed to prevent the Building Official from requiring compliance with higher requirements than those contained herein where such higher requirements are essential to maintain a safe and sanitary condition.

SECTION G-102 CAPACITY OF SEPTIC TANKS

G-102.1 Liquid capacity. The liquid capacity of all septic tanks shall conform to Tables G-102A and G-102B as determined by the number of bedrooms or apartment units in dwelling occupancies, and the occupant load or the number of plumbing fixture units as determined from Table 403.1, whichever is greater, in other building occupancies. The capacity of any one septic tank and its drainage system shall be limited by the soil structure classification as specified in Tables G-102C and G-103.

**TABLE G-102A
CAPACITY OF SEPTIC TANKS^a FOR SINGLE-FAMILY DWELLINGS**

SINGLE FAMILY DWELLINGS ^b — NUMBER OF BEDROOMS	MULTIPLE DWELLING UNITS ^c OR APARTMENTS— ONE BEDROOM EACH	OTHER USES—MAXIMUM FIXTURE UNITS ^d SERVED (Table 403.1)	MINIMUM SEPTIC TANK CAPACITY (gallons)
1 or 2	2 units	15	750
3		20	1,000
4		25	1,200
5 or 6	3	33	1,500
	4	45	2,000
	5	55	2,250
	6	60	2,500
	7	70	2,750
	8	80	3,000
	9	90	3,250
	10	100	3,500

a. Septic tank sizes in this Table include sludge storage capacity and the connection of domestic food waste disposal units without further volume increase.

b. Extra bedroom, 150 gallons each.

c. Extra dwelling units more than 10, 250 gallons each.

d. Extra fixture units more than 100, 25 gallons per fixture unit.

**TABLE G-102B
CAPACITY OF SEPTIC TANKS FOR OTHER THAN SINGLE-FAMILY DWELLINGS**

TYPE OF BUILDING	DAILY PER CAPITA ^a (gallons)	BASIC FACTOR
Grammar school	15	Per classroom (35 students per classroom)
Grammar school with cafeteria	20	
High school with cafeteria and shower baths	25	
Factories	20 (without showers) 25 (with showers)	Each 8-hour shift Each 8-hour shift
Restaurants	50	Per seat
Trailer parks—Community baths	50	3 persons per trailer
Trailer parks—Private baths or independent trailers	60	3 persons per trailer
Motels—Baths and toilets	50	3 persons per unit
Motels—Bath, toilet and kitchen	60	3 persons per unit
Self-service laundry	300	Per machine
Drive-in theaters	5	Per car

a. Normal sludge storage capacity is included, except waste from food disposal units.

TABLE G-102C
SEPTIC TANK SIZE

REQUIRED LEACHING AREA (square feet per 100 gallon septic tank capacity)	MAXIMUM SEPTIC TANK SIZE ALLOWABLE (gallons)
20 – 25	7,500
40	5,000
60	3,500
90	3,000

SECTION G-103 **AREA OF DISPOSAL FIELDS AND SEEPAGE PITS**

G-103.1 Absorption area. The minimum effective absorption area in disposal fields, in square feet of trench bottom, and in seepage pits, in square feet of sidewall, shall be predicated on the required septic tank capacity, in gallons, and shall conform to Table G-103 as determined for the type of soil found in the excavation, and shall be as follows:

- (a) When disposal fields are installed, a minimum of 150 square feet of trench bottom shall be provided for each system exclusive of any hardpan, rock, clay or other impervious formations. For large, specially designed and approved systems, sidewall areas in excess of the required 12 inches, and not to exceed 36 inches below the leach line, may be added to the 150 square feet of trench bottom area when computing absorption areas.
- (b) The minimum effective absorption area in any seepage pit shall be calculated as the excavated sidewall area below the inlet exclusive of any hardpan, rock, clay or other impervious formations. The minimum required area of porous formation shall be provided in one or more seepage pits. No excavation shall extend into the water table, nor to a depth where sewage may contaminate underground water stratum that is usable for domestic purposes. Each seepage pit shall have a minimum sidewall, not including the arch, of 10 feet below this inlet.
- (c) Soils, other than those listed in Table G-103, shall be tested for porosity as required by Section G-104.

TABLE G-103
RATED ABSORPTION CAPACITIES OF FIVE TYPICAL SOILS

TYPES OF SOIL	REQUIRED LEACHING MAXIMUM ABSORPTION CAPACITY	
	AREA (square feet per 100 gallons)	GALLONS (per square foot of leaching area for a 24-hour period)
Coarse sand or gravel	20	5
Fine sand	25	4
Sandy loam or sandy clay	40	2.5
Clay with considerable sand or gravel	60	1.66
Clay with small amount of sand or gravel	90	11

SECTION G-104 **PERCOLATION TESTS**

G-104.1 Field and pit sizes. Wherever practicable, disposal field and seepage pit sizes shall be computed from Table G-103.

G-104.2 Tests.

G-104.2.1 Percolation test. In order to determine the absorption qualities of questionable soils, other than those listed in Table G-103, the proposed site shall be subjected to percolation tests acceptable to the Chief Plumbing Inspector.

G-104.2.2 Clear water. Each test shall be performed with clear water in an excavation that has been thoroughly soaked prior to the test.

G-104.2.3 Absorption capacity. When a percolation test is required, the proposed system shall have the capability to absorb a quantity of clear water in a 24-hour period equal to at least five times the liquid capacity of the proposed septic tank. No private disposal system shall be permitted to serve a building if a percolation test shows that the absorption capacity of the soil is less than 1.11 gallons per square foot of leaching area per 24 hours.

SECTION G-105 **SEPTIC TANK CONSTRUCTION**

G-105.1 Plans. Plans for all septic tanks shall be submitted to the Chief Plumbing Inspector for approval. Such plans shall show all dimensions, reinforcing, structural calculations and such other pertinent data as may be required. Independent laboratory tests and calibrations shall be provided for prefabricated septic tanks as required by the Chief Plumbing Inspector.

G-105.2 Materials. Septic tanks shall be constructed of sound durable materials, not subject to excessive corrosion or decay, and shall be water tight. Each such tank shall be structurally designed to withstand all anticipated earth or other loads, and shall be installed level and on a solid bed.

G-105.3 Design.

G-105.3.1 Concrete. The walls and floor of each cast-in-place concrete septic tank shall be monolithic. The maximum length of any section of unreinforced concrete septic tank wall shall be 6 feet and no cross section of any such unreinforced concrete wall or floor shall be less than 5 inches thick. The minimum compressive strength of any concrete septic tank wall, top and cover, or floor, shall be 2,500 pounds per square inch (psi).

G-105.3.2 Steel. The minimum wall thickness of any steel septic tank shall be 0.105 inch, and each such tank shall be protected from corrosion both externally and internally by an approved bituminous coating or other acceptable means.

G-105.3.3 Compartments. Septic tanks shall have a minimum of two compartments. The inlet compartment of any septic tank shall be not less than two-thirds of the total capacity of the tank nor 500 gallons liquid capacity, and shall be at least 3 feet wide and 5 feet long. Liquid depth shall be not less than 2 feet, 6 inches nor more than 6 feet.

The secondary compartment of any septic tank shall have a minimum capacity of 250 gallons and a maximum capacity of one-third of the total capacity of such tank. The secondary compartment of septic tanks having a capacity of more than 1,500 gallons shall be not less than 5 feet long.

G-105.3.4 Depth. The total depth shall be not less than 9 inches greater than the liquid depth. The cover of the septic tank shall be at least 2 inches above the back vent openings.

G-105.3.5 Protection. All concrete septic tanks shall be protected from corrosion by coating the inside with an approved bituminous coating or other acceptable means. The coating shall extend to at least 4 inches below the water line and shall cover all of the internal area above that point.

G-105.4 Covers.

G-105.4.1 Concrete. Concrete septic tank covers shall be reinforced and shall have a minimum compressive strength of 2,500 psi.

G-105.4.2 Loads. All septic tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (psf) when the maximum coverage does not exceed 3 feet.

G-105.4.3 Standards. Septic tank design shall be such as to produce a clarified effluent consistent with accepted standards, and shall provide adequate space for sludge and scum accumulations.

G-105.5 Access. Access to each septic tank shall be provided by at least two manholes of 20 inches minimum dimension or by an equivalent removable cover slab. One access manhole cover shall be located over the inlet and one access manhole shall be located over the outlet. Wherever a first compartment exceeds 12 feet in length, an additional manhole shall be provided over the baffle wall. Septic tanks installed under concrete or blacktop paving shall have the required manholes accessible by either extending the manhole openings to grade in a manner acceptable to the Chief Plumbing Inspector, or by providing a removable concrete or other approved section, 20 inches minimum in the least dimension, in such concrete or blacktop paving, which is located directly over the required septic tank manholes.

G-105.6 Inlet and outlet pipes.

G-105.6.1 Water level. The inlet and outlet pipe or baffle shall extend 4 inches above and at least 12 inches below the water surface. The invert of the inlet pipe shall be at a level not less than 2 inches above the invert of the outlet pipe.

G-105.6.2 Vent area. Inlet and outlet pipe fittings or baffles, and compartment partitions, shall have a free vent area equal to the required cross-sectional area of the house sewer or private sewer discharging there into to provide free ventilation above the water surface from the disposal field or seepage pit through the septic tank, house sewer and stack to the outer air.

G-105.6.3 Partitions or baffles. Partitions or baffles between compartments shall be of sound, durable material

and shall extend at least 4 inches above the liquid level. An inverted fitting equivalent in size to the tank inlet, but in no case less than 4 inches in size, shall be installed in the inlet-compartment side of the baffle with the bottom of the fitting placed midway in the depth of the liquid. Wooden baffles are prohibited.

SECTION G-106 DISPOSAL FIELDS

G-106.1 General.

G-106.1.1 Distribution lines. Distribution lines shall be constructed of tile laid with open joints, except that perforated clay tile, perforated plastic pipe or other approved materials may be used, provided that sufficient openings are available for the distribution of the effluent into the trench area.

G-106.1.2 Drainage fill. Before placing filter material or drain lines in a prepared excavation, all smeared or compacted surfaces shall be removed from trenches by raking to a depth of 1 inch and the loose material removed. Clean stone, gravel, slag or similar filter material, acceptable to the Chief Plumbing Inspector and varying in size from $\frac{3}{4}$ inch to $2\frac{1}{2}$ inches, shall be placed in the trench to the depth and grade required by this Section. Drain pipe shall be placed on filter material in an approved manner. The drain lines shall then be covered with filter material to the maximum depth required by this Section and then covered with untreated building paper, straw or similar porous material to prevent closure or voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and approval.

G-106.1.3 Seepage pits. When seepage pits are used in combination with disposal fields, the filter material in the trenches shall terminate at least 5 feet from the pit excavation, and the line extending from such points to the seepage pit shall be approved pipe with water-tight joints.

G-106.1.4 Distribution box. Where two or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines shall be constructed at the head of each disposal field. The inverts of all outlets shall be level and the invert of the inlet shall be at least 1 inch above the outlets. Suitable baffles shall be provided to ensure equal flow. Distribution boxes shall be built on a level concrete slab installed in natural or compacted soil.

G-106.1.5 Laterals. All laterals from an approved distribution box to the disposal field where the grade exceeds 6 inches per 100 feet shall be bell and spigot vitrified clay or other approved pipe with water-tight joints. Multiple disposal field laterals, wherever practicable, shall be of uniform length.

G-106.1.6 Connections. Connections between a septic tank and a distribution box, or between a distribution box and drainfield, shall be laid with approved water-tight joints on natural ground or compacted fill.

G-106.1.7 Siphon tanks. Automatic siphon or dosing tanks shall be installed when required or as permitted by the Chief Plumbing Inspector.

G-106.1.8 Disposal fields. Disposal fields shall be constructed as follows:

Minimum number of drain lines per field	1
Maximum length of each line	100 feet
Preferred depth of cover over lines	18 inches
Maximum bottom width of trench	36 inches
Minimum spacing of lines center to center	6 feet
Minimum depth of earth cover over lines	12 inches
Preferred depth of cover over lines	18 inches
Maximum grade of lines (*)	6 inches per 100 feet
Minimum grade of lines (*)	3 inches per 100 feet
Minimum filter material under drain lines	12 inches
Minimum filter material over drain lines	2 inches

Minimum spacing between trenches or leaching beds shall be 4 feet plus 2 feet for each additional foot of depth in excess of 1 foot below the bottom of the drain line.

(*) When perforated pipe is used, it shall be laid level and with the end of the line capped.

G-106.1.9 Leaching beds. Where leaching beds are permitted in lieu of trenches, the area of each such bed shall be at least 50 percent greater than the tabular requirements for trenches. Distribution drain lines in leaching beds shall be not more than 6 feet apart on centers and no part of the perimeter of the leaching bed shall be more than 3 feet from a distribution drain line.

G-106.1.10 Slopes. When necessary on sloping ground to prevent excessive line slope, leach lines or leach beds shall be stepped. The lines between each horizontal section shall be made with water-tight joints and shall be designed so each horizontal leaching trench or bed shall be utilized to the maximum capacity before the effluent shall pass to the next lower leach line or bed.

SECTION G-107 SEEPAGE PITS

G-107.1 Capacity. The capacity of seepage pits shall be based on the quantity of liquid waste discharging there into, and on the character and porosity of the surrounding soil, and shall conform to Section G-103.

G-107.2 Multiple pits. Multiple seepage pit installations shall be served through an approved distribution box or connected in series by means of a water-tight connection laid on undisturbed or compacted soil. The outlet from the pit shall have an approved fitting extending at least 12 inches below the inlet fitting.

G-107.3 Construction.

G-107.3.1 Size and shape. Each seepage pit shall be circular in shape and shall have an excavated diameter of not less

than 4 feet. Each such pit shall be lined with approved-type, whole, new hard-burned clay brick, concrete brick, concrete circular-type cesspool blocks or other approved materials. Approval shall be obtained prior to construction of any pit having an excavated diameter greater than 5 feet.

G-107.3.2 Lining. The lining in every seepage pit shall be laid on a firm foundation. Lining materials shall be placed tight together and laid with joints staggered. Except in the case of approved-type, precast concrete circular sections, no brick or block shall be greater in height than its width and shall be laid flat to form at least a 4-inch wall. Brick or block greater than 12 inches long shall have chamfered matching ends and shall be scored to provide for seepage. Excavation voids behind the brick, block or concrete liner shall have a minimum of 6 inches of clean $\frac{3}{4}$ -inch gravel or rock, and shall be progressively backfilled while the lining is being installed.

G-107.3.3 Masonry. All brick or block used in seepage pit construction shall have a minimum compressive strength of 2,500 psi.

G-107.3.4 Sidewall. Each seepage pit shall have a minimum sidewall (not including the arch) of 10 feet below the inlet.

G-107.3.5 Arch construction. The arch or dome of any seepage pit may be constructed in one of three ways:

- Approved-type, hard-burned clay brick, or solid concrete brick or block, laid in cement mortar.
- Approved brick or block laid dry. For the materials in Paragraph (a), an approved cement mortar covering at least 2 inches thick shall be applied and extend at least 6 inches beyond the sidewalls of the pit.
- Approved-type, one- or two-piece reinforced concrete slab of 2,500 psi minimum compressive strength, not less than 5 inches thick and designed to support an earth load of not less than 400 psf. Each such cover shall be provided with a 9-inch-minimum inspection hole with plug or cover, and shall be coated on the underside with an approved bituminous or other nonpermeable protective compound.

G-107.3.6 Coverage. The top of the arch or cover shall be at least 18 inches, but not more than 4 feet below the surface of the ground.

G-107.3.7 Inlet fitting. An approved vented inlet fitting shall be provided in every seepage pit so arranged as to prevent the inflow from damaging the sidewall.

SECTION G-108 CESSPOOLS

G-108.1 Where used.

G-108.1.1 Temporary. A cesspool shall be considered only as a temporary expedient, pending the construction of a public sewer, as an overflow facility when installed in conjunction with an existing cesspool, or as a means of sewage disposal for limited, minor or temporary uses only when special approval is granted by the Chief Plumbing Inspector.

G-108.1.2 Limited uses. Where it is established that a public sewer system will be available in less than 12 months, and soil and ground water conditions are favorable for cesspool disposal, cesspools without septic tanks may be installed for single-family dwellings or other limited uses when special approval is granted by the Chief Plumbing Inspector.

G-108.2 Construction. Each cesspool, when permitted, shall conform to the construction requirements set forth in Section G-107 for seepage pits, and shall have a minimum sidewall (not including the arch) of 20 feet below the inlet, provided, however, that when a strata of gravel or equally pervious material 4 feet thick is found, the depth of such sidewall need not be more than 10 feet below the inlet.

G-108.3 Additions. When overflow cesspools or seepage pits are added to existing installations, the effluent shall leave the existing pit through an approved vented leg extending at least 12 inches downward into such existing pit and having its outlet flow line at least 6 inches below the inlet. All pipe between pits shall be laid with approved water-tight joints.

SECTION G-109 ABANDONED FACILITIES

G-109.1 Capping. Every abandoned building (house) sewer, or part thereof, shall be plugged or capped in an approved manner within 5 feet of the property line.

G-109.2 Filling. Every cesspool, septic tank and seepage pit, which has been abandoned or has been discontinued otherwise from further use, or to which no waste or soil pipe from a plumbing fixture is connected, shall have the sewage removed therefrom and be completely filled with earth, sand, gravel, concrete or other approved material.

G-109.3 Inspection. The top cover or arch over the cesspool, septic tank or seepage pit shall be removed before filling and the filling shall not extend above the top of the vertical portions of the sidewalls or above the level of any outlet pipe until inspection has been made, following which the cesspool septic tank or seepage pit shall be filled to the level of the top of the ground.

G-109.4 Responsible party. No person owning or controlling any cesspool, septic tank or seepage pit on his own premises, or in any abutting portion of a public street, alley or other public property, shall fail, refuse or neglect to comply with the provisions of this Section.

G-109.5 Time limit. Where disposal facilities are abandoned consequent to connecting any premises with the public sewer, the permittee making the connection shall fill all abandoned facilities as required by the Chief Plumbing Inspector within 30 days from the time of connection to the public sewer.

APPENDIX H

HOSPITAL PLUMBING SYSTEM

SECTION H-101 GENERAL

H-101.1 Scope.

H-101.1.1 Intent. The provisions of this Appendix are intended to set out those items of hospital plumbing systems that differ from plumbing systems in other buildings. Special care shall be accorded the hospital plumbing system because of its direct relationship to adequate medical care and the need for added protection for patients and hospital personnel from health hazards.

H-101.1.2 Codes. It is understood that hospital plumbing systems shall conform not only to the requirements of this Appendix, but also to the requirements contained in the other Sections of this Code.

H-101.1.3 Application. The provisions of this Appendix shall apply to special plumbing installation in clinics, doctors offices, nursing homes, etc., as well as in hospital installations.

H-101.2 Definitions. The following words and terms shall, for the purposes of this Appendix and as stated elsewhere in this Code, have the meanings shown herein. Refer to Chapter 2 for general definitions.

- (a) **Aspirator.** A fitting or device supplied with water or other fluid under positive pressure that passes through an integral orifice or constriction causing a vacuum. Aspirators are often referred to as suction apparatus, and are similar in operation to an ejector.
- (b) **Autopsy table.** A fixture or table used for the post-mortem examination of a body.
- (c) **Bedpan hopper.** See Clinical Sink.
- (d) **Bedpan steamer or boiler.** A fixture used for scalding bedpans or urinals by the direct application of steam or boiling water.
- (e) **Bedpan unit.** A small workroom in the nursing area designed and equipped for emptying, cleaning, and sometimes for steaming bedpans, and for no other purpose.
- (f) **Bedpan washer and sterilizer.** A fixture designed to wash bedpans and to flush the contents into the sanitary drainage system. It may also provide for emptying, cleaning, and sometimes for steaming bedpans, and for no other purpose.
- (g) **Bedpan Washer hose.** A device supplied with hot and cold water, located adjacent to a water closet or clinical sink to be used for cleansing bedpans.
- (h) **Clinical sink (bedpan hopper).** A fixture meeting the design requirements of Subsection G-102.1 for the rinsing of bedpans and soiled linen. Such fixtures shall have a trap size of not less than 3 inches.

- (i) **Effective opening.** The minimum cross-sectional area at the point of water supply discharge, measured or expressed in terms of (1) diameter of a circle, or (2) if the opening is not circular, the diameter of a circle of equivalent cross-sectional area. Applicable to air gap.
- (j) **Nurses' station.** An area in the nursing unit separated from the corridor by a counter or desk, designed to permit nurses to record and file each patient's history and progress; observe and control the corridor; prepare medicines; and maintain contact with patients, the hospital and the outside by local and public means of communication.
- (k) **Scrub sink.** A device usually located in the operating suite to enable operating personnel to scrub their hands prior to an operating procedure. The hot and cold water supply is activated by a knee-action mixing valve, or by wrist or pedal control.
- (l) **Sterilizer, boiling type.** A fixture (nonpressure type) used for boiling instruments, utensils and other equipment (used for disinfection). Some devices are portable, others are connected to the plumbing system.
- (m) **Sterilizer, instrument.** A device for the sterilization of various instruments.
- (n) **Sterilizer, pressure (autoclave).** A fixture (pressure vessel) designed to use steam under pressure for sterilizing. Also called an autoclave.
- (o) **Sterilizer, pressure instrument washer-sterilizer.** A fixture (pressure vessel) designed to both wash and sterilize instruments during the operating cycle of the fixture.
- (p) **Sterilizer, utensil.** A device for the sterilization of utensils as used in hospital services.
- (q) **Sterilizer vent.** A separate pipe or stack, indirectly connected to the building drainage system at the lower terminal, that receives the vapors from nonpressure sterilizers or the exhaust vapors from pressure sterilizers, and conducts the vapors directly to the outer air. Sometimes called vapor, steam, atmospheric or exhaust vent.
- (r) **Sterilizer water.** A device for sterilizing water and storing sterile water.
- (s) **Still.** A device used for distilling liquids.
- (t) **Utility room.** A workroom in the patient nursing area, designed and equipped to facilitate preparation, cleaning and incidental sterilization of the various supplies, instruments, utensils, etc., involved in nursing treatment and care, exclusive of medications handled in nurses' stations, and bedpan cleaning and sterilizing.

SECTION H-102 FIXTURES

H-102.1 Bedpans. Acceptable flush rim bedpan hoppers (clinic sink), bedpan washers, and/or other acceptable fixtures and equipment shall be provided for the disposing of bedpan contents, and the cleaning and disinfection of bedpans in soiled utility (hopper) rooms.

H-102.2 Clinic sink. A clinic sink shall have an integral trap in which the upper portion of a visible trap seal provides a water surface. The fixture shall be so designed as to permit complete removal of the contents by siphonic or blowout action, or both, and to reseal the trap. A flushing rim shall provide water to cleanse the interior surface. The fixture shall have flushing and cleaning characteristics similar to a water closet.

H-102.3 Prohibited use of clinic and service sinks. A clinic sink serving a soiled utility room shall not be considered a substitute for, nor shall it be used as, a janitor's service sink. A janitor's service sink shall not be used for the disposal of urine, fecal matter or other human waste.

H-102.4 Ice Prohibited in soiled utility room. Machines for manufacturing ice, or any device for the handling or storage of ice, shall not be located in a soiled utility room. Machines for manufacturing ice, or devices for the handling or storage of ice intended for either human consumption or packs, may be located in a clean utility room, floor pantry or diet kitchen.

H-102.5 Sterilizer equipment requirements.

H-102.5.1 Cleaning. It shall be unlawful to descale or otherwise submit the interior of water sterilizers, stills or similar equipment to acid or other chemical solutions while the equipment is connected to the water or drainage system.

H-102.5.2 Data plate. New pressure sterilizers and pressure instrument washer-sterilizers hereafter installed shall display, in a location clearly visible at all times, the ASME Standard symbol and data plate.

H-102.5.3 Accessibility. All sterilizer piping and devices necessary for the operation of sterilizers shall be accessible for inspection and maintenance, and shall satisfy the following:

- (a) Steam supplied to sterilizers, including those connected by pipes from overhead mains or branches, shall be drained to prevent any excess moisture from reaching the sterilizer. The condensate drainage from the steam supply shall be discharged by gravity.
- (b) Steam condensate returns from sterilizers shall not be connected to pressure or vacuum return systems; only gravity returns shall be acceptable. Steam condensate returns from sterilizers shall not be connected to overhead mains or branches.
- (c) Pressure sterilizers should be equipped with an acceptable means of condensing and cooling the exhaust steam vapors. Nonpressure sterilizers should be equipped with an acceptable device that

will automatically control the vapors in a manner so as to confine them within the vessel, or equipped with an acceptable means of condensing and cooling the vapors.

- (d) Gas-fired equipment or apparatus, requiring either water or drainage connections, or both, shall meet the standards of the American National Standards Institute (ANSI).

H-102.6 Special elevations. Control valves, vacuum outlets and devices that protrude from a wall of an opening, emergency, recovery, examining or delivery room, or in a corridor or other locations where patients may be transported on a wheeled stretcher, shall be so located at an elevation that will preclude bumping the patient or stretcher against the device. When necessary, to install at a low elevation, safety precautions should be taken to protect the personnel.

H-102.7 Plumbing in mental hospitals. In mental hospitals, special consideration should be given to piping, controls and fittings of plumbing fixtures as required by the types of mental patients being treated. Pipes or traps should not be exposed, and fixtures should be substantially bolted through walls.

SECTION H-103 DRAINAGE AND VENTING

H-103.1 Ice storage chest drains. Any drain serving an ice storage chest or box shall discharge over an indirect waste receptor separate from all other fixture wastes. Each terminal shall discharge through an air gap above the receptor. The end shall be covered with a removable screen of not less than 10 mesh per square inch and, if discharging vertically, the terminal shall be cut at an angle of 45 degrees.

H-103.2 Bedpan washers and clinic sinks. Bedpan washers and clinic sinks shall be connected to the soil pipe system and vented following the requirements as applied to water closets, except that bedpan washers require additional local vents.

H-103.3 Sterilizer wastes.

H-103.3.1 Indirect wastes required. All sterilizers shall be provided with individual and separate indirect wastes, with air gaps of not less than two diameters of the waste tailpiece. The upper rim of the receptor-, funnel- or basket-type waste fitting shall be not less than 2 inches below the vessel or piping, whichever is lower. Except as provided in Subsections H-103.3.2 and H-103.3.4, a "P" trap shall be installed on the discharge side of, and immediately below, the indirect waste connection serving each sterilizer.

H-103.3.2 Recess room floor drain.

H-103.3.2.1 Drain required. In all recess rooms containing the recessed or concealed portions of sterilizers, not less than one acceptable floor drain, connecting to the drainage system, shall be installed in a manner to drain the entire floor area.

H-103.3.2.2 Size and installation. The recess room floor drain waste and trap shall be a minimum diameter of 3 inches. It shall receive the drainage from at least

one sterilizer within the recess room to ensure maintenance of the floor drain trap seal. The sterilizer drain shall be installed on a branch taken off between the floor drain trap and the drain head. An individual waste trap shall not be required on this type of installation.

H-103.3.3 Prohibited connections. Branch funnel and branch basket-type fittings, except as provided in Subsection H-103.3.4, are prohibited on any new installation or when relocating existing equipment. Existing branch funnel or branch basket-type installations shall be provided with an acceptable indirect waste below the branch connections.

H-103.3.4 Battery assemblies. A battery assembly of not more than three sterilizer wastes may drain to one trap, provided the trap and waste are sized according to the combined fixture unit rating, the trap is located immediately below one of the indirect waste connections, the developed distance of a branch does not exceed 8 feet, and the branches change direction through a tee-wye or wye pattern fitting.

H-103.3.5 Bedpan steamers, additional trap required. A trap with a minimum seal of 3 inches shall be provided in a bedpan steamer drain located between the fixture and the indirect waste connection.

H-103.3.6 Pressure sterilizer. Except when an exhaust condenser is used, a pressure sterilizer chamber drain may be connected to the exhaust drip tube before terminating at the indirect waste connection. If a vapor trap is used, it shall be designed and installed to prevent moisture from being aspirated into the sterilizer chamber. The jacket steam condensate return, if not connected to a gravity steam condensate return, shall be separately and indirectly wasted. If necessary to cool a high-temperature discharge, a cooling receiver, trapped on its discharge side, may serve as the fixture trap.

H-103.3.7 Pressure sterilizer exhaust condensers. The drain from the condenser shall be installed with an indirect waste as prescribed in this Code. If condensers are used on pressure sterilizers, the chamber drain shall have a separate indirect waste connection.

H-103.3.8 Water sterilizer. All water sterilizer drains, including tank, valve leakage, condenser, filter and cooling, shall be installed with indirect waste or according to Subsection H-103.3.2.1.

H-103.3.9 Pressure instrument washer-sterilizer. The pressure instrument washer-sterilizer chamber drain and overflow may be interconnected. Also, they may be interconnected with the condensers. The indirect waste shall follow the provisions set forth in this Code.

H-103.4 Aspirators. In operating rooms, emergency rooms, recovery rooms, delivery rooms, examining rooms, autopsy rooms and other locations, except laboratories, where aspirators are installed for removing blood, pus or other fluids, the discharge from any aspirator shall be indirectly connected to the drainage system. The suction line shall be provided with a bottle or similar trap to protect the water supply.

H-103.5 Vacuum system stations. Vacuum system station locations shall be considered from the standpoint of convenience and practical use. The receptacles should be built into cabinets or recesses, but shall be visible and readily accessible.

H-103.6 Bottle system. Vacuum (fluid suction) systems intended for collecting, removing or disposing of blood, pus or other fluids by the so-called bottle system shall be provided with receptacles, which are equipped with an overflow preventative device at each vacuum outlet station. Each vacuum outlet station should be equipped with a secondary safety receptacle as an additional safeguard against fluids, other than air entering the vacuum piping system.

H-103.7 Central disposal system equipment. All central vacuum (fluid suction) systems shall ensure continuous service. Systems equipped with collecting or control tanks shall provide for draining and cleaning of the tanks while the system is in operation. In hospitals or line institutions having emergency power provisions, the system shall be capable of remaining in service during the use of emergency power. The exhausts from a vacuum pump used in connection with a vacuum (fluid suction) system shall discharge separately to the outer atmosphere above the roof. The exhaust discharge shall not create a nuisance or hazard within, without, around or about the premises.

H-103.8 Central vacuum and disposal systems.

H-103.8.1 Connection. The waste from a central vacuum (fluid suction) system of the disposal type, which is connected to the drainage system, whether the disposal be by barometric lag, collection tanks or bottles, shall be directly connected to the sanitary drainage system through a trapped waste.

H-103.8.2 Pipe and sizing. The piping of a central vacuum (fluid suction) system shall be of corrosion-resistant material having a smooth interior surface. A branch shall be not less than $\frac{1}{2}$ inch for one outlet and sized according to the number of vacuum outlets, and a main shall be not less than 1 inch. The pipe sizing shall be increased according to the manufacturer's recommendation as stations are increased. All piping shall be provided with adequate and accessible cleanout facilities on mains and branches, and shall be accessible for inspection, maintenance and replacements.

H-103.9 Water systems for space cooling and heating condensate drains. The lowest point of a condensate riser or risers shall be trapped and discharged over an indirect waste sink. The trap may be either "P" or a "running trap" with a cleanout. A branch shall be installed upstream from the condensate drain, and the trap shall be located above the lowest floor level of the building.

H-103.10 Vent material. Material for local vents serving bedpan washers and sterilizer vents serving sterilizers shall be sufficiently rustproof, erosion and corrosion resistant to withstand intermittent wetting and drying from steam vapors; the distilled water-solvent action of the steam vapors; and frequent and immediate changes of temperatures.

H-103.11 Vent connections prohibited. Connections between local vents serving bedpan washers, sterilizer vents serving sterilizing apparatus and normal sanitary plumbing systems are prohibited. Furthermore, only one type of apparatus shall be served by a given vent.

H-103.12 local vents and stacks.

H-103.12.1 Size. Bedpan washers shall be vented to the outer atmosphere above the roof by means of one or more local vents. The local vent for a bedpan washer shall be not less than a 2-inch-diameter pipe. A local vent serving a single bedpan washer may drain to the fixture served.

H-103.12.2 Multiple installations. Where bedpan washers are located above each other on more than one floor, a local vent stack may be installed to receive the local vent on the various floors. More than three bedpan washers shall not be connected to a 2-inch local vent stack, six to a 3-inch local vent stack, and 12 to a 4-inch local vent stack. In multiple installations, the connections between a bedpan washer local vent and a local vent stack shall be made by use of the tee or tee-wye sanitary pattern drainage fittings, installed in an upright position.

H-103.12.3 Trap required. The bottom of the local vent stack, except when serving only one bedpan washer, shall be drained by means of a trapped and vented waste connection to the plumbing sanitary drainage system. The trap and waste shall be the same as the local vent stack.

H-103.12.4 Trap seal maintenance. A water supply of not less than $\frac{1}{4}$ -inch minimum tubing shall be taken from the flush supply of each bedpan washer on the discharge or fixture side of the vacuum breaker, trapped to form not less than a 3-inch seal, and connected to the local vent stack on each floor. The water supply shall be so installed as to provide a supply of water to the local vent stack for cleansing and drain trap seal maintenance each time a bedpan washer is flushed.

H-103.13 Sterilizer vents and stacks.

H-103.13.1 Vent connections. Multiple installations of pressure and nonpressure sterilizers shall have their vent connections to the sterilizer vent stack made by means of inverted wye fittings. Such vent connections shall be accessible for inspection and maintenance.

H-103.13.2 Drainage. The connection between sterilizer vent or exhaust openings and the sterilizer vent stack shall be designed and installed to drain to the funnel- or basket-type waste fitting. In multiple installations, the sterilizer vent stack shall be drained separately to the lowest sterilizer funnel- or basket-type waste fitting or receptor.

H-103.14 Sterilizer Vent stack sizes.

H-103.14.1 Bedpan steamers. The minimum diameter of a sterilizer vent serving a bedpan steamer shall be $1\frac{1}{2}$ inches. Multiple installations shall be sized according to Table H-103.14A.

H-103.14.2 Boiling-type sterilizers. The minimum diameter of a sterilizer vent stack shall be 2 inches when serving a utensil sterilizer, and $1\frac{1}{2}$ inches when serving an instrument sterilizer. Combinations of building-type sterilizer vent connections shall be based on Table H-103.14A.

H-103.14.3 Pressure sterilizers. Sterilizer vent stacks shall be $2\frac{1}{2}$ inches minimum; those serving combinations of pressure sterilizer exhaust connections shall be sized according to Table H-103.14B.

H-103.14.4 Pressure instrument washer-sterilizer sizes. The minimum diameter of a sterilizer vent stack serving an instrument washer-sterilizer shall be 2 inches. Not more than two sterilizers shall be installed on a 2-inch stack, and not more than four on a 3-inch stack.

H-103.15 Radioactive materials. All radioactive materials shall be disposed of in a manner so as not to create a hazard to operation and maintenance personnel of the institution or to the public. Specific permission shall be secured from the Building Official to dispose of any radioactive material to the drainage system.

TABLE H-103.14A
STACK SIZES FOR BEDPAN STEAMERS AND BUILDING-TYPE STERILIZERS (inches)
(Number of Connections of Various Sizes Permitted to Various Sized Sterilizer Vent Stacks)

STACK SIZE (inches)	CONNECTION SIZE (inches)		
	$1\frac{1}{2}$	2	3
$1\frac{1}{2}$ ^a	1	or	0
2	2	or	1
2 ^b	1	and	1
3 ^a	4	or	2
3 ^b	2	and	2
4 ^a	8	or	4
4 ^b	4	and	4

a. Total of each size.

b. Combination of sizes.

TABLE H-103.14B
STACK SIZES FOR PRESSURE STERILIZERS (inches)
 (Number of Connections of Various Sizes Permitted to Various Sized Vent Stacks)

STACK SIZE (inches)	CONNECTION SIZE (inches)			
	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$
$1\frac{1}{2}$ ^a	3 or	2 or	1 or	1
$1\frac{1}{2}$ ^b	2 and	1		
2 ^a	6 or	3 or	2 or	1
2 ^b	3 and	2		
2 ^b	2 and	1 and	1	
2 ^b	1 and	1 and	1	
3 ^a	15 or	7 or	5 or	3
3 ^b		1 and	2 and	2
	1 and	5 and		1

a. Total of each size.

b. Combination of sizes.

SECTION H-104 WATER SUPPLY

H-104.1 Water service. All hospitals shall have dual services installed in a manner to provide an uninterrupted supply of water in case of a water main break.

H-104.2 Hot water heater and tanks. The hot water heating equipment shall have sufficient capacity to supply $6\frac{1}{2}$ gallons of water at 125°F per hour per bed for hospital fixtures; 4 gallons of water at 180°F per hour per bed for kitchens; and $4\frac{1}{2}$ gallons of water at 180°F per hour per bed for laundry. The hot water storage tank or tanks shall have a capacity equal to 80 percent of the heater capacity. Where direct-fired hot water heaters are used, they shall be of an approved high-pressure type. Submerged steam heating coils should be of copper. Storage tanks shall be fabricated of noncorrosive metal or be lined with noncorrosive metal.

H-104.3 Hot water supply system. Hot water circulating systems and risers should be run from the hot water storage tank to a point directly below the highest fixture at the end of each branch main. Where the building is higher than three stories, each riser shall be circulated. Each main, branch main, riser and branch to a group of fixtures of the water system shall be valved.

H-104.4 Vacuum breaker installations.

H-104.4.1 Flood level. Vacuum breakers shall be installed a minimum of 6 inches above the flood level rim of the fixture or device in accordance with Section 608. For ordinary hose connections, the maximum height at which any hose is to be used shall be treated as its flood level.

H-104.4.2 Low-volume flows. Where low-volume flows might cause leaking or spitting at the vacuum breaker parts, back pressure may be developed by installing an acceptable minimum orifice valve on the discharge side of the vacuum breaker. This shall be in addition to the regular control valve. This type of installation shall be subject to

review and approval by the Chief Plumbing Inspector before installation.

H-104.5 Prohibited water closet and clinic sink supply. Jet- or water-supplied orifices, except those supplied by the flush connections, shall not be located in or connected with a water closet bowl or clinic sink. This Section shall not prohibit an acceptable bidet installation.

H-104.6 Clinical, hydrotherapeutic and radiological equipment. All clinical, hydrotherapeutic, radiological or any equipment, whether mentioned or not, that is water supplied or discharges to the waste system, shall meet the requirements of this Section and this Code covering cross connectors, air gaps, vacuum breakers and check valves. Special equipment and devices found under these classes include those listed in Table H-104.6.

H-104.7 Condensate drain trap seal. A water supply shall be provided for cleaning, flushing and resealing the condensate trap. The source of water supply shall be a refrigerator condenser discharge, a drinking fountain waste, or other acceptable methods of flushing and releasing the trap. The water supply shall be not less than a $\frac{1}{2}$ -inch-diameter pipe and shall discharge through an air gap not less than twice the diameter of the supply pipe.

H-104.8 Valve leakage diverter. Each water sterilizer that may be filled with water through directly connected piping shall be equipped with an acceptable leakage diverter and/or bleed-line on the water supply control valve to indicate and conduct any leakage of unsterile water away from the sterile zone.

SECTION H-105 OXYGEN SYSTEMS

H-105.1 Installation. Where oxygen systems are installed, the oxygen piping, outlets, manifold rooms and storage rooms should be installed in accordance with the requirements of NFPA 99C.

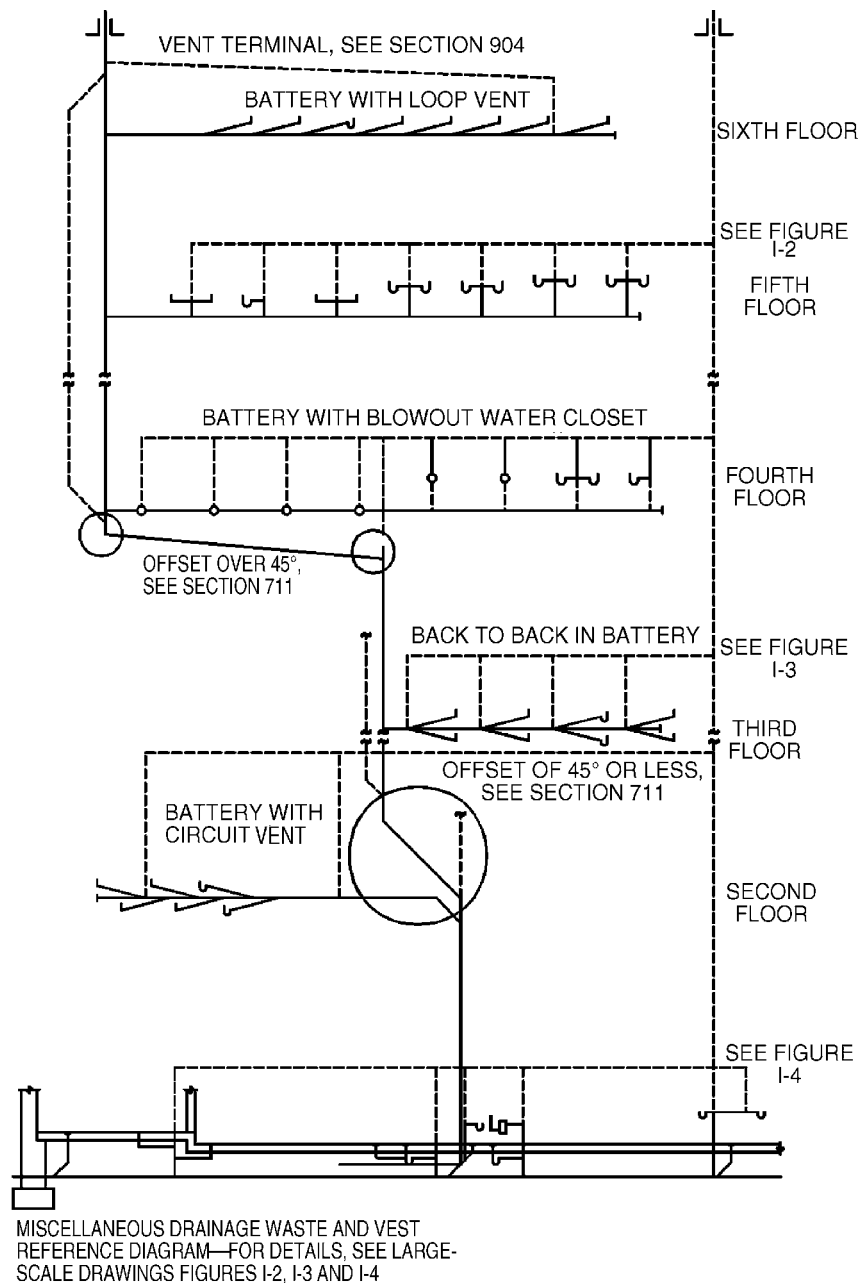
TABLE H-104.6
CLASSES OF CLINICAL, HYDROTHERAPEUTIC AND RADIOLOGICAL EQUIPMENT

CLINICAL	HYDROTHERAPEUTIC	RADIOLOGICAL	OTHER
Dental cuspidors	Control units	Diagnostic x-ray	Violet ray
Surgical cuspidors	Arm bath	Therapy x-ray	Photographic developing
Dental (flush rim) lavatories	Leg bath	X-ray transformers	
	Tub bath	X-ray oil tank	Film developing
Sitz bath	Immersion bath	Diffraction	
Emergency bath	Shower bath	X-ray developing	Microscopic
Receiving bath	Needle bath		
Prenatal bath	Tank		
Infant bath	Pool		
Prophylaxis	Hose		
Shampoo	Syringe douche		
Massage			

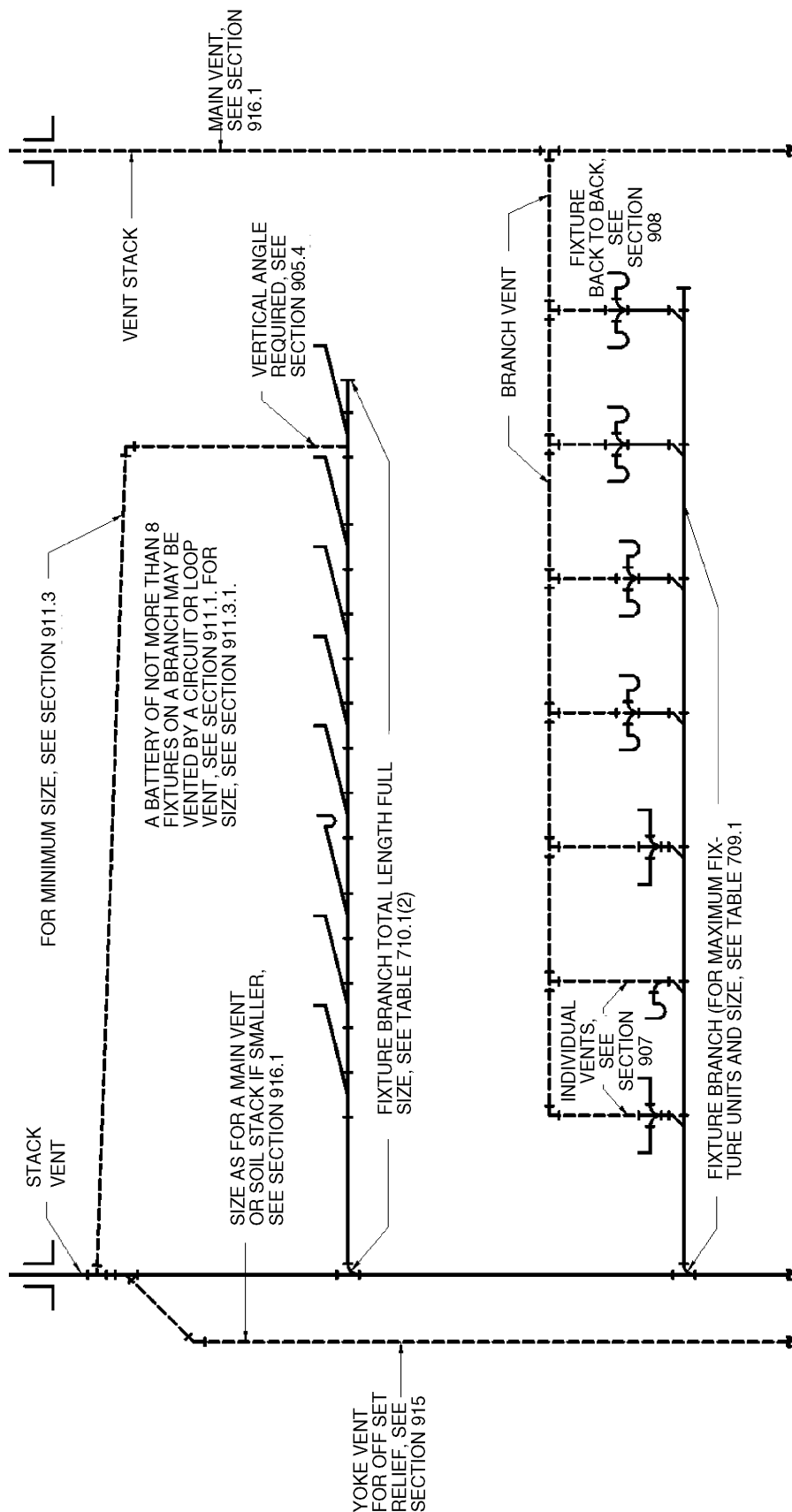
APPENDIX I ILLUSTRATIONS

To aid in interpreting this Code, the following Figures have been included in this 2015 edition. The figures are not to be construed as superseding the written text, but merely to illustrate. The various methods indicated diagrammatically do not limit other configurations of the design of plumbing, soil, waste and vent systems, water piping, accessories, etc., when

in compliance with the written text. It is further suggested that the users of these illustrations refer to the appropriate Sections and Standards regarding any of the Figures to avoid misunderstanding.



**FIGURE I-1
MISCELLANEOUS DRAINAGE, WASTE AND VENT REFERENCE DIAGRAM**



SEE SMALL-SCALE DRAWING OF FIGURE I-1 FOR ENTIRE SYSTEM.

FIGURE I-2
LARGE-SCALE DETAIL OF FIGURE I-1

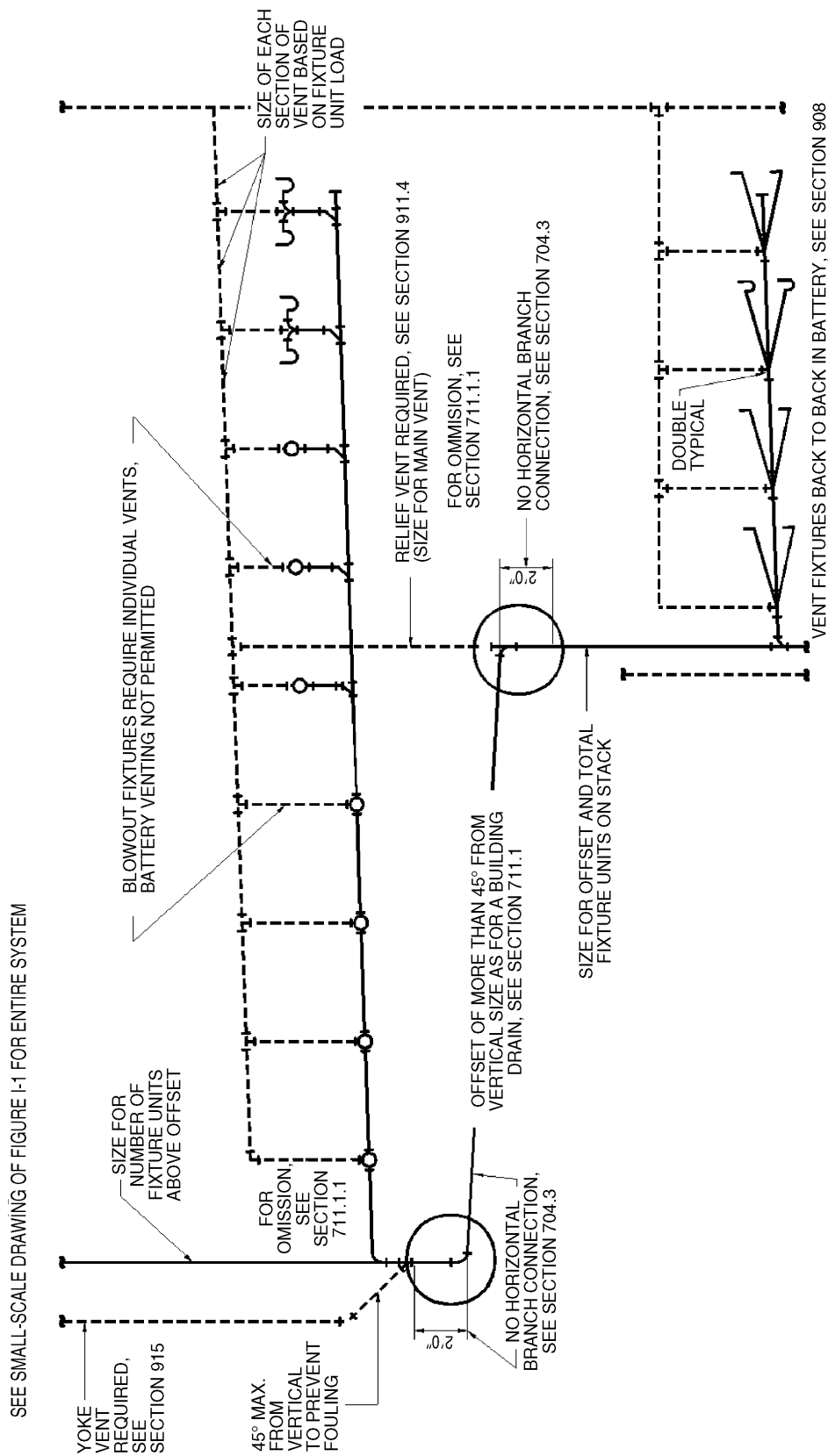


FIGURE I-3
LARGE-SCALE DETAIL OF FIGURE I-1

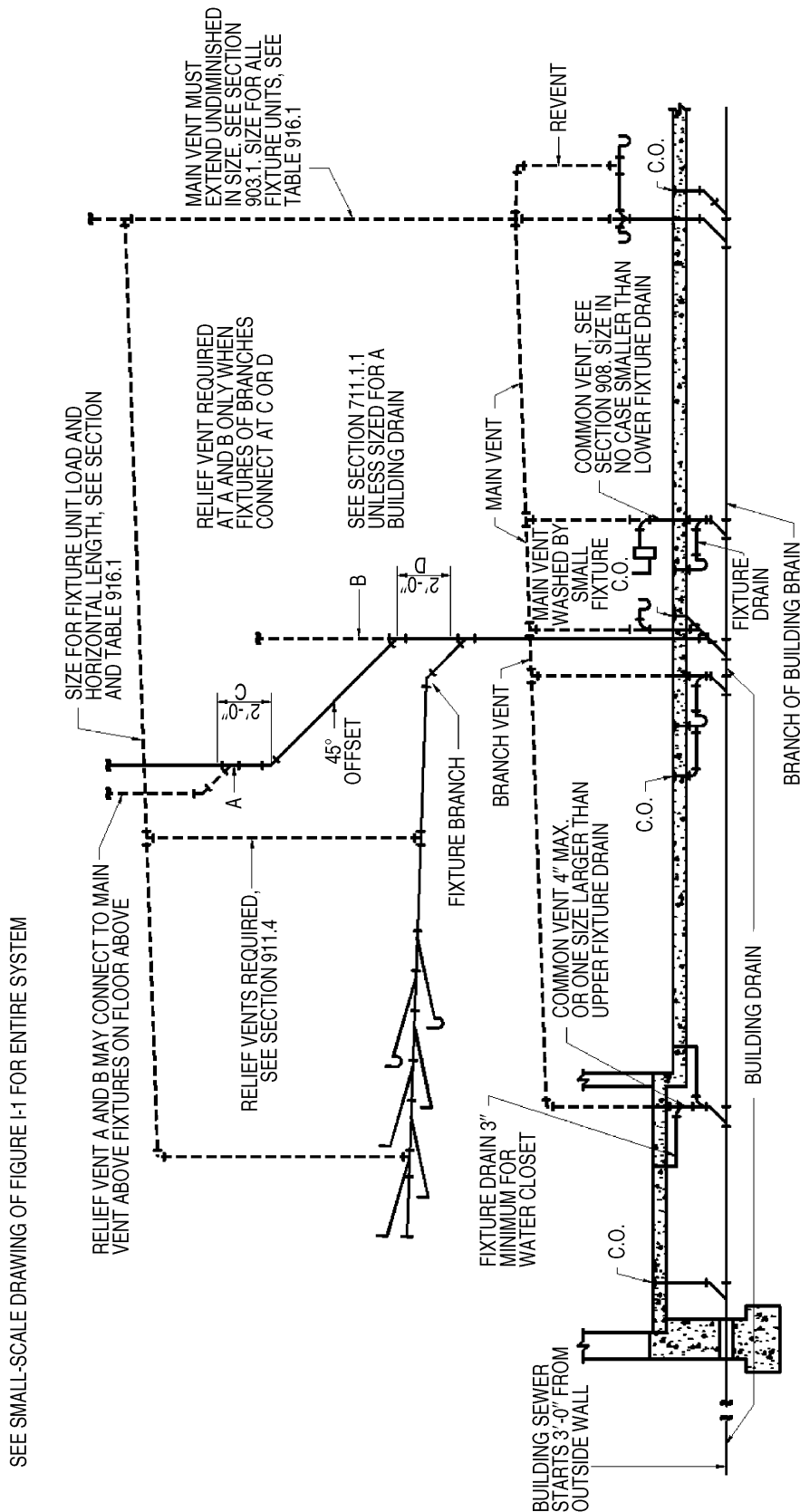
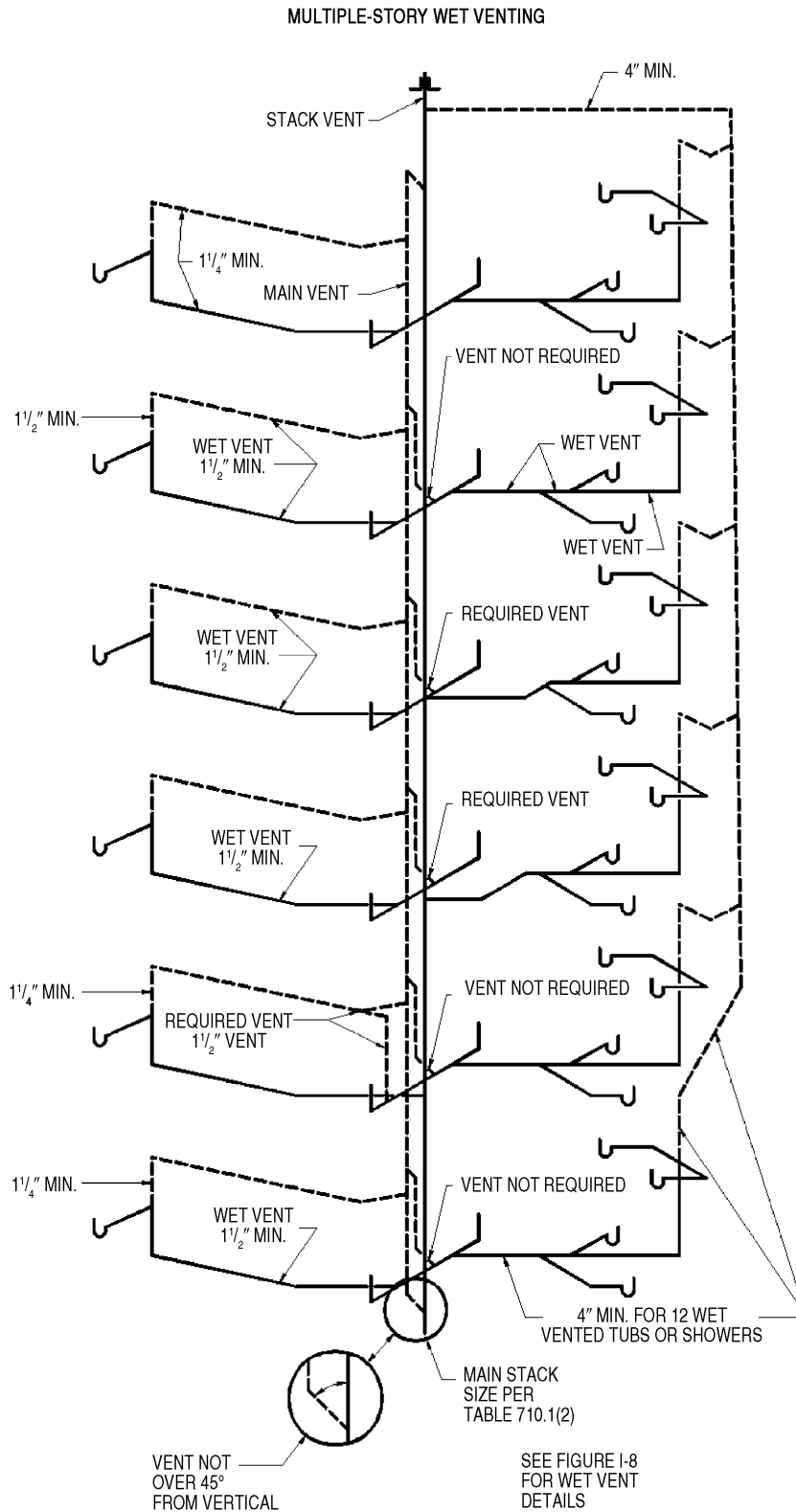


FIGURE I-4
LARGE-SCALE DETAIL OF FIGURE I-1



**FIGURE I-5
MAIN VENT CONNECTED AT BASE OF STACK VENT**

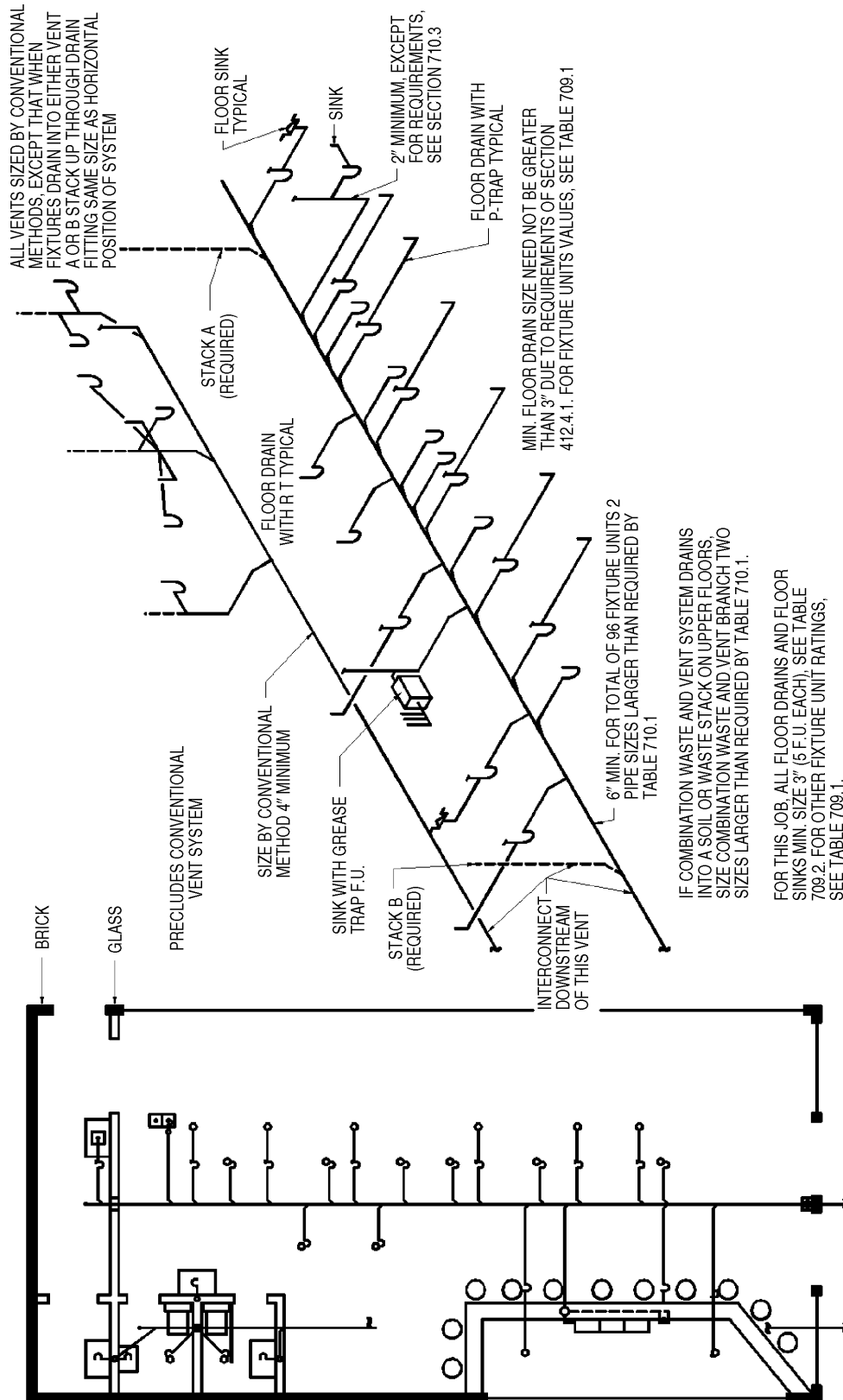
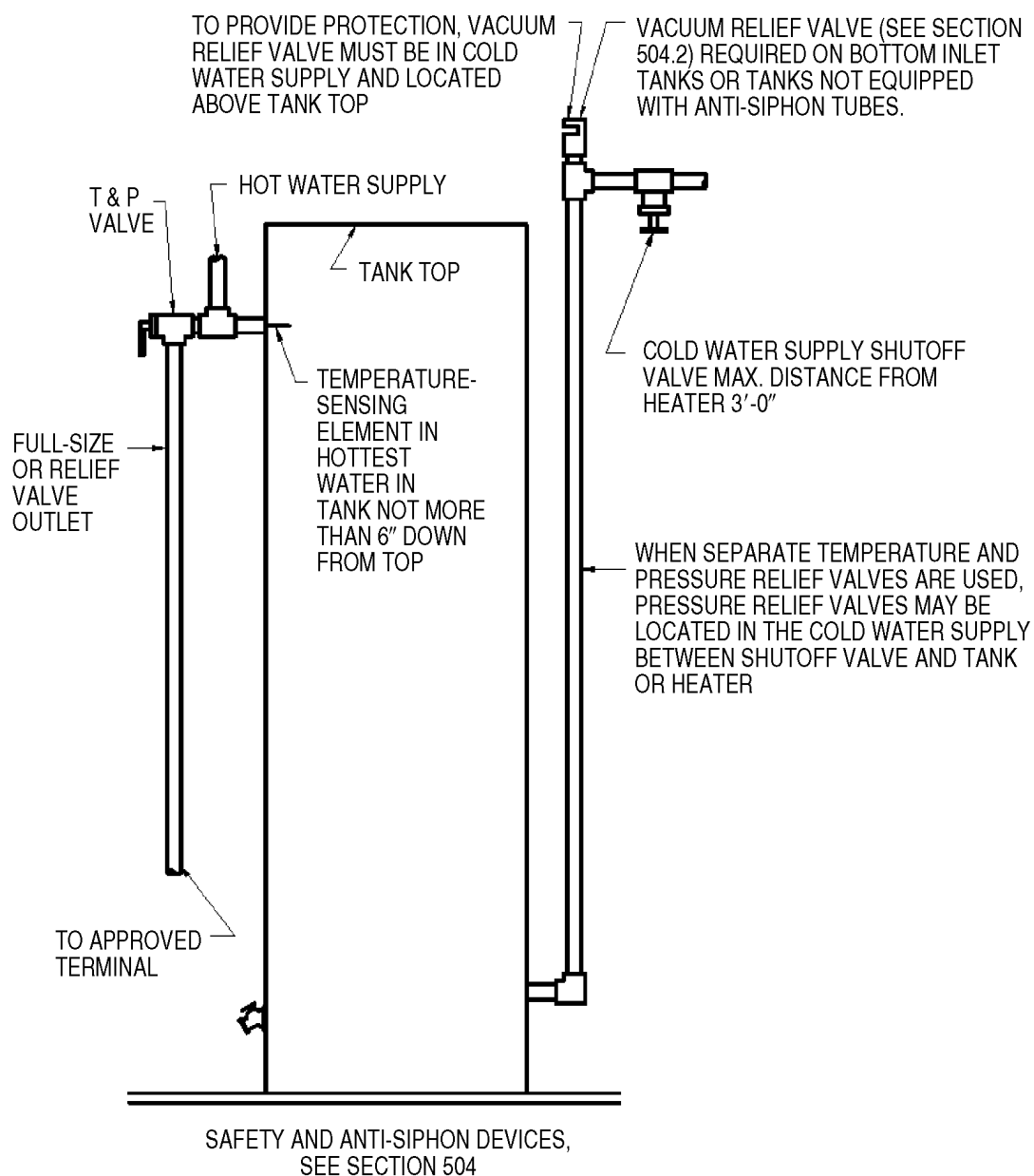


FIGURE I-6
COMBINATION WASTE AND VENT SYSTEM



**FIGURE I-7
BACKSIPHON AND SAFETY PROTECTION**

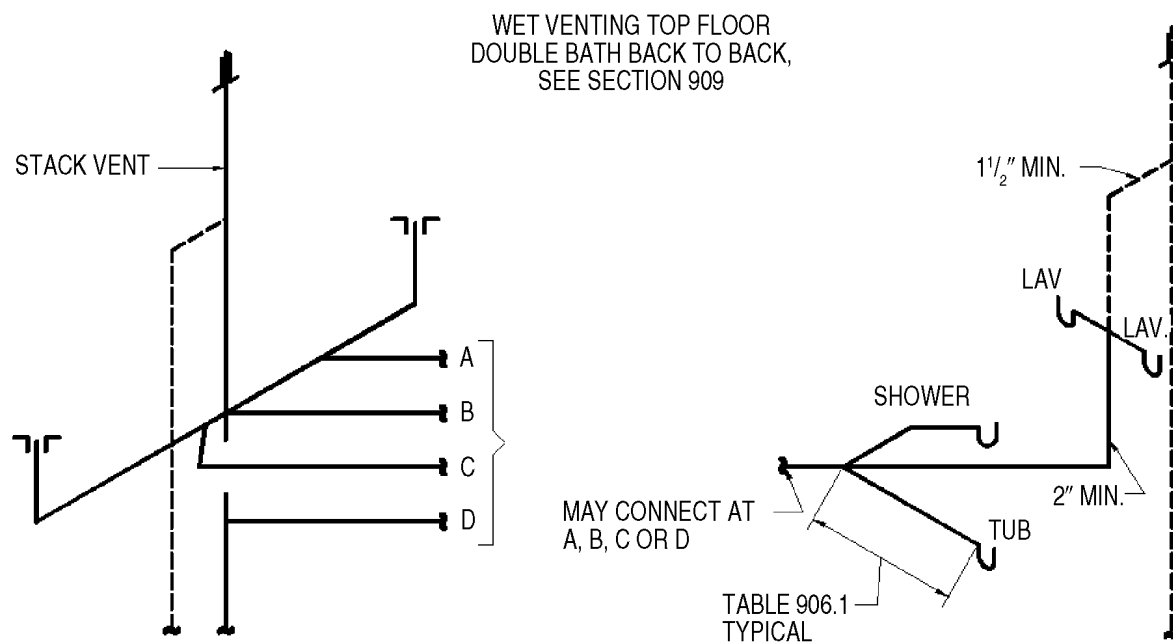


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